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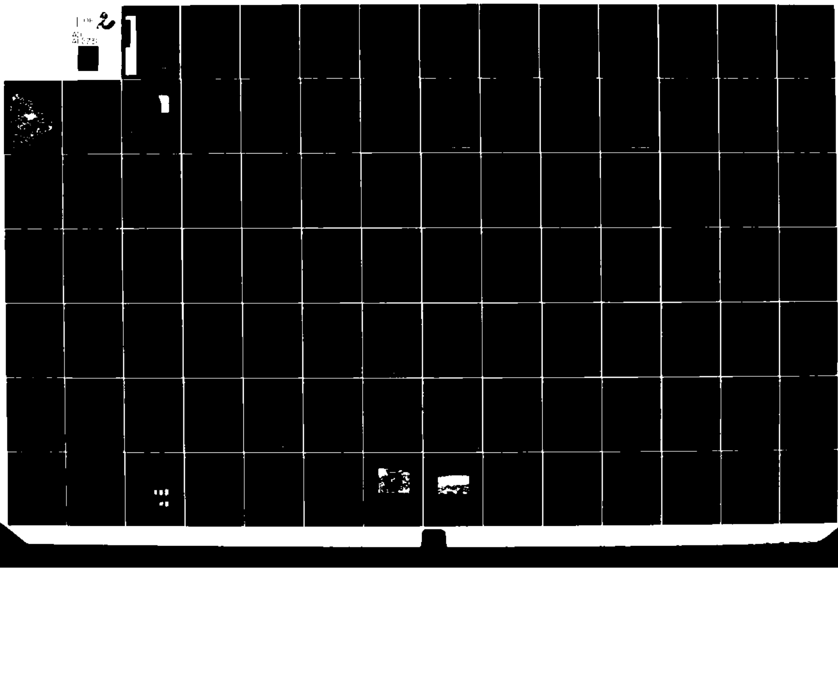

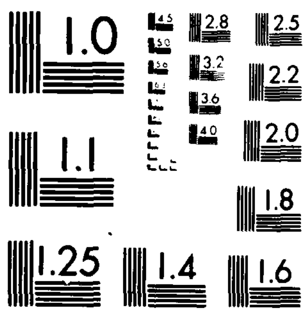

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MX SITING INVESTIGATION
GEOTECHNICAL EVALUATION

AGGREGATE RESOURCES STUDY
WHITE RIVER VALLEY
NEVADA

PREPARED FOR
BALLISTIC MISSILE OFFICE (BMO)
NORTON AIR FORCE BASE, CALIFORNIA

FUGRO
NATIONAL, INC.
Consulting Engineers and Geologists

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This report contains the Valley-Specific Aggregate Resources Study for White River Valley, Nevada. It is the third in a series of reports that contain valley-specific aggregate information on the location and suitability of basin-fill and rock sources for concrete and road-base construction materials. Field reconnaissance and limited laboratory testing, existing data from the State of Nevada Department of Highways, previous regional aggregate investigation, and ongoing Verification studies provide the basis for the findings presented.

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FN-TR-37-c

AGGREGATE RESOURCES STUDY

WHITE RIVER VALLEY

NEVADA

Prepared for:

U.S. Department of the Air Force
Ballistic Missile Office (BMO)
Norton Air Force Base, California 92409

Prepared by:

Fugro National, Inc.
3777 Long Beach Boulevard
Long Beach, California 90807

6 June 1980

FOREWORD

This report was prepared for the Department of the Air Force Ballistic Missile Office (BMO) in compliance with Contract No. F04704-80-C-0006, CDRL Item No. 004A2. It presents the results of Valley-Specific Aggregate Resources studies within and adjacent to selected areas in Utah and Nevada that are under consideration for siting the MX system.

This volume contains the results of the aggregate resources study in White River Valley, Nevada. It is the third of several Valley-Specific Aggregate Resources investigations which will be prepared as separate volumes. Results of this report are presented as text, appendices, and two drawings.

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EXECUTIVE SUMMARY

This report contains the Valley-Specific Aggregate Resources Study (VSARS) for White River Valley; Nevada. It is the third in a series of reports that contain valley-specific aggregate information on the location and suitability of basin-fill and rock sources for concrete and road-base construction materials. Field reconnaissance and limited laboratory testing, existing data from the State of Nevada Department of Highways, previous regional aggregate investigation, and ongoing Verification studies provide the basis for the findings presented.

A classification system based on aggregate type and potential use was developed to rank the suitability of all basin-fill and rock aggregate sources. Four aggregate types have been designated; coarse, fine, and coarse and fine (multiple) aggregates derived from basin-fill sources and crushed rock aggregates derived from rock sources. Each aggregate type was then classified using the following definitions:

Class I — Potentially suitable concrete aggregate and road-base material source.

Class II — Possibly unsuitable concrete aggregate/potentially suitable road-base material source.

Class III — Unsuitable concrete aggregate or road-base material source.

Decisions on assigning a particular aggregate source to one of the three classes were determined from Fugro National and existing laboratory aggregate tests performed as part of this

study (abrasion resistance, soundness, and alkali reactivity), and to a lesser degree, field visual observations.

Emphasis in this study was placed on the identification of Class I basin-fill, coarse aggregate. These deposits are considered to be the primary sources of concrete and road-base construction materials. Results of the study are presented on a 1:125,000 scale aggregate resources map (Drawing 2) and are summarized as follows:

1. Coarse Aggregate - Three major Class I coarse aggregate basin-fill deposits were located in the valley study area.

   a. An extensive alluvial fan (Aafg) complex west of the Egan Range in east-central White River Valley.

   b. Older lacustrine deposits (Au, Aol) in the southern portion of White River Valley and northern Pahranagat Valley south of the study area.

   c. Alluvial fan deposits (Aafs) bordering the Grant and Horse ranges in west-central White River Valley.

   Potential Class II coarse aggregate sources are widespread and extensive in the study area. Although boundaries of specific deposits could not be delineated, they are typically located within alluvial fans flanking Class I and/or Class II rock sources.

2. Fine Aggregate - Most coarse aggregate basin-fill sources are also potential multiple sources (coarse and fine) that will supply varying quantities of fine aggregate either from

the natural deposit or during processing. However, specific alluvial fan deposits (Aafs), predominantly comprised of Class I fine aggregate material were identified at the northern end of the Golden Gate Range in the central valley area.

3. Crushed Rock - Abundant Class I crushed rock sources surround the study area and consist of:

   a. The Guilmette Formation (Cau) composed primarily of limestone and dolomites are widespread throughout the study area;

   b. The Eureka Quartzite (Qtz) is of limited areal extent; but where it is exposed in the central valley area (Egan, Grant, and Horse ranges) should make an excellent Class I source.

   c. Undifferentiated volcanics (Vu) composed of andesitic and rhyolitic tuffs of limited areal extent are located in the northwest portion of the study area (Horse Range).

The useability of any of these rock units as sources of crushed rock aggregate will depend on their location and accessibility within the study area and minability.

Additional aggregate testing and field investigations will be required to further refine the lateral and vertical extents of classification boundaries and define exact physical and chemical characteristics of a particular deposit or rock source within the valley.

1.0 INTRODUCTION

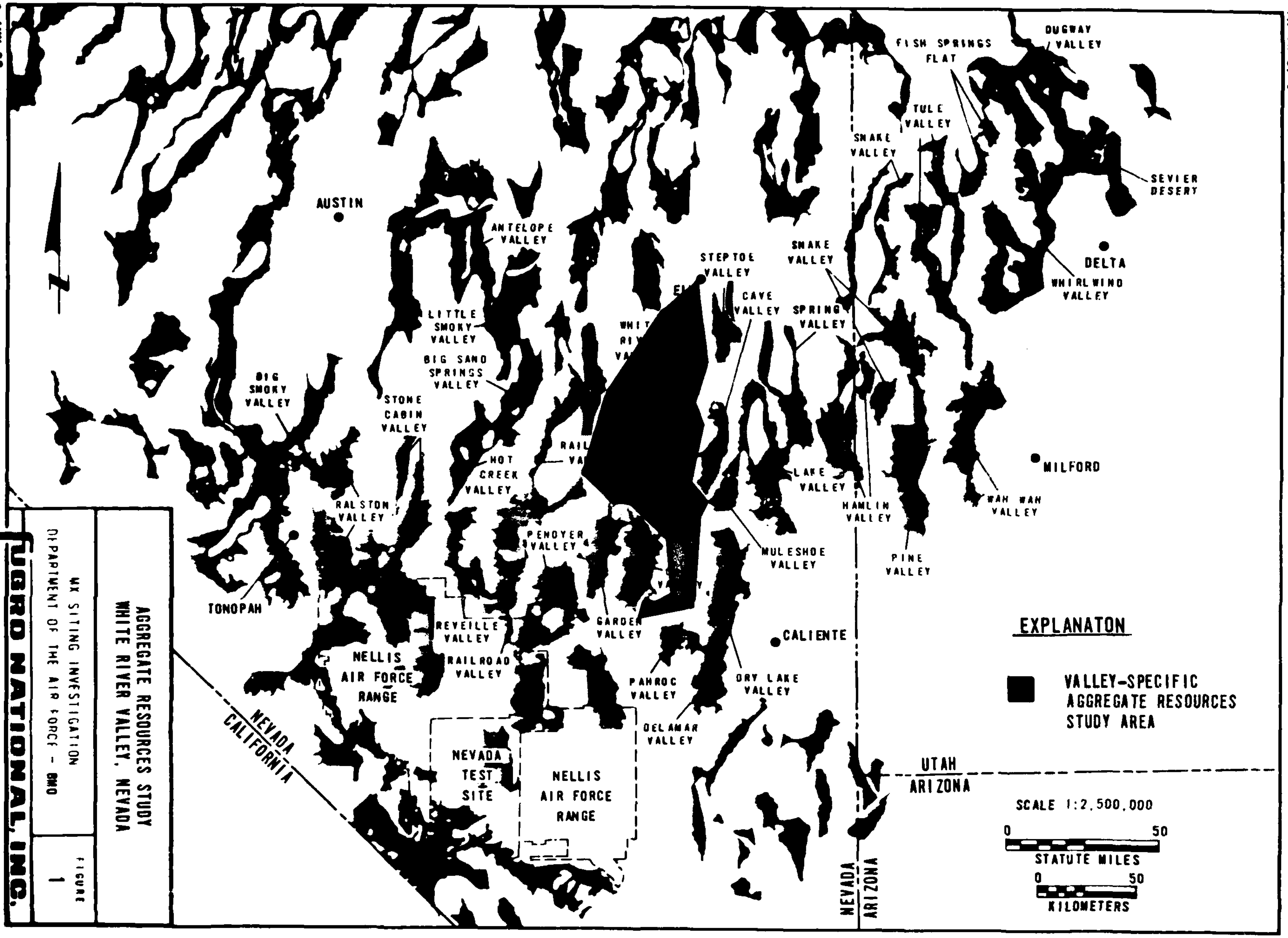
1.1 STUDY AREA

This report presents the results of the Valley-Specific Aggregate Resources Study completed for White River Valley (Figure 1). Located in northeastern Nye County, northwestern Lincoln County, and southwestern White Pine County, Nevada, the area is elongate in shape with a north-south trending alluvial basin flanked by carbonate and volcanic rock mountain ranges. Railroad and Coal valleys border the site on the west and Steptoe, Cave, and Dry Lake valleys form the eastern boundary.

U.S. Highway 6 provides access along the northern boundary and State Highway 38, in part a paved and improved gravel road, traverses White River Valley from north to south along the eastern border. A network of unpaved roads and 4-wheel-drive trails crisscross the site area (Drawing 1).

The valley is mainly comprised of desert rangeland that is administered by the BLM. Humboldt National Forest is located within and adjacent to the northern end of the White River Valley study area. Several active mining operations are located at the north end of the Egan Range and are serviced by a spur of the Union Pacific Railroad. The towns of Preston, Lund, and Sunnyside, Nevada, lie along the east-central portion of the valley-specific area (Drawing 2).

FN-TR-37-c



AGGREGATE RESOURCES STUDY
WHITE RIVER VALLEY, NEVADA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

FIGURE 1

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1.2 BACKGROUND

The MX aggregate program began in 1977 with the investigation of Department of Defense (DOD) and Bureau of Land Management (BLM) lands in California, Nevada, Arizona, New Mexico, and Texas (FN-TR-20D). Refinement of the MX siting area added portions of Utah and Nevada that were not studied in the initial Aggregate Resources Evaluation Investigation (AREI) (Figure 2). This additional area (Figure 1), defined as the Utah Aggregate Resources Study area (UARSA), was evaluated in Fall 1979 and a second general aggregate resources report (FN-TR-34) was submitted on 3 March 1980. Both general aggregate investigations were designed to provide regional information on the general location, quality, and quantity of aggregates that could be used in the construction of the MX system.

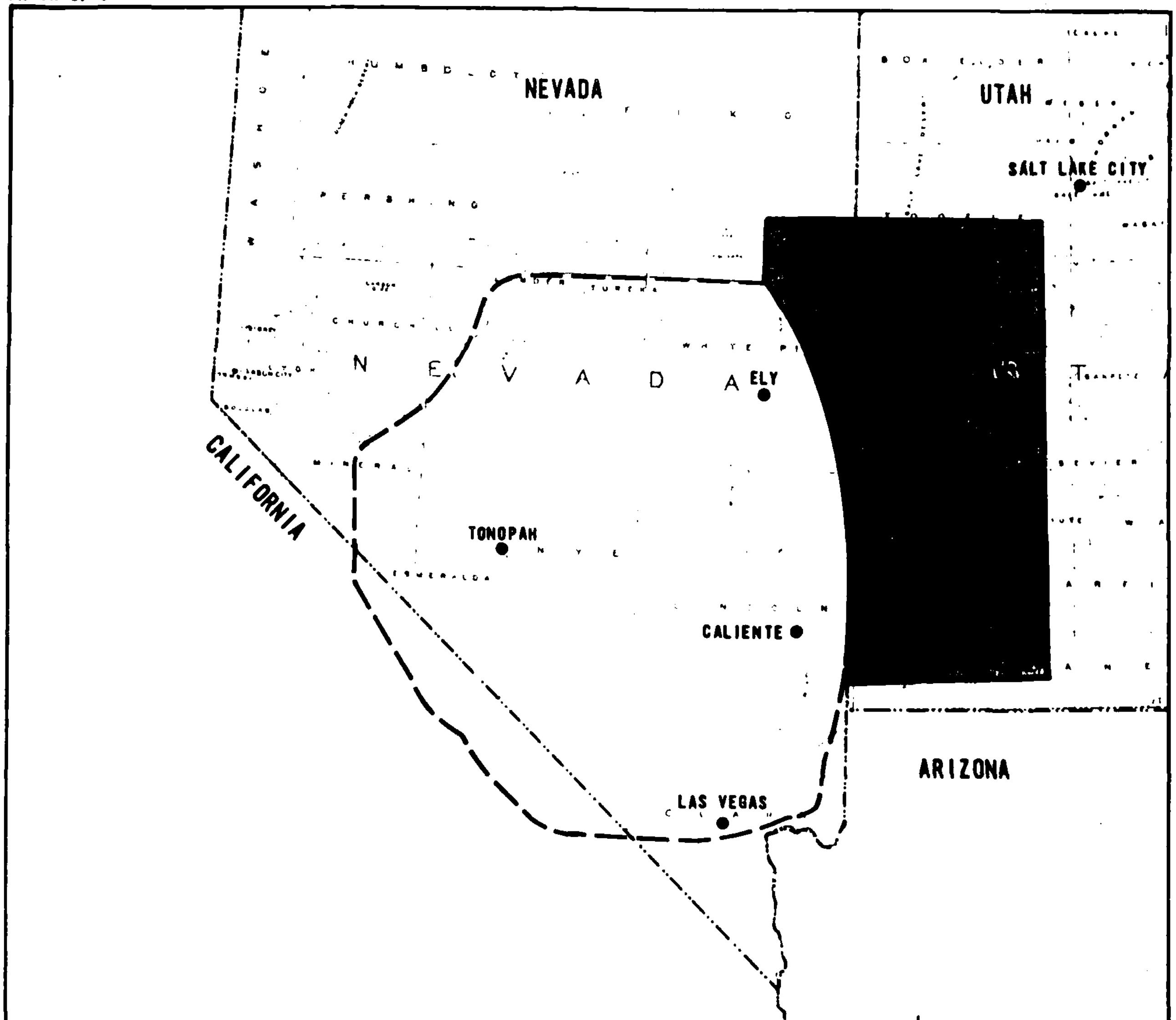
Subsequent to the general studies, Valley-Specific Aggregate Resources Studies (VSARS) were developed in FY 79 to provide more detailed information on potential aggregate sources in specified valley areas.

1.3 OBJECTIVES

The primary objective of the VSARS program is to classify on a valley basis, basin-fill deposits and rock for suitability as concrete and road-base construction materials.

The VSARS format is designed to select and present the locations of the most acceptable aggregate sources for preliminary construction planning and follow-on, detailed aggregate investigations.

FN-TR-37-c



EXPLANATION

NEVADA-CALIFORNIA AGGREGATE RESOURCES EVALUATION INVESTIGATION FY 78 (FN-TR-20D)

UTAH AGGREGATE RESOURCES STUDY, FY 79 (FN-TR-34)

SCALE 1: 5,000,000

0 50 100
STATUTE MILES

0 50 100
KILOMETERS

UTAH-NEVADA REGIONAL AGGREGATE STUDIES

MX SITING INVESTIGATION
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FIGURE 2

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1.4 SCOPE

The scope of this investigation required office and field investigations and included the following:

(1) Collection and analysis of available existing data on the quality and quantity of potential concrete aggregate and road base material sources. American Society of Testing and Materials (ASTM) standards and Standard Specifications for Public Works Construction (SSPWC) were used to evaluate quality.

(2) Aerial and ground reconnaissance of all identified potential aggregate sources in the valley area, with more detailed investigation and sample collection of likely basin-fill (coarse and fine aggregates) and rock (crushed rock aggregates) construction material sources.

(3) Laboratory testing to supplement available existing data and to provide detailed information to assist in determining the suitability of specific basin-fill or rock deposits as construction material sources within the valley area.

(4) Development and application of an aggregate classification system (Section 2.5) that emphasizes aggregate type (coarse, fine, or crushed rock) and potential construction use (concrete and/or road base).

2.0 STUDY APPROACH

2.1 EXISTING DATA

Collection of existing test data from available sources was an important factor in the VSARS program. The principal source of existing data directly pertaining to aggregate construction materials was obtained from the State of Nevada Department of Highways (Appendix A). The majority of this information is related to the use of aggregate material for asphaltic concrete, base course in road construction, or ballast material. However, many of the suitability tests for these types of construction materials are similar to those for concrete and were applicable to this investigation (Appendix A).

2.2 SUPPLEMENTAL FUGRO NATIONAL DATA

Supplemental Fugro National data was obtain from: (1) field data and supplementary test data compiled during the general aggregate resources study (FN-TR-20D), (2) White River Valley Verification study (FN-TR-27-V), and (3) the current Valley-Specific Aggregate Resources Study (Appendix A).

Although the primary objective of the initial, general aggregate study was directed toward developing regional evaluations and rankings of all potential aggregate sources, the 21 data points included in the Valley-Specific study area (Drawing 2) also supplied specific aggregate information. These 21 stops contained two 100-pound samples collected for limited laboratory testing (Appendix A).

Verification geologic maps were an initial source of information on the type and extent of basin-fill deposits within the valley area. In addition verification study data included information from two trench locations in the central portion of the valley (Drawing 1, Appendix A1). Depths of the two selected trenches ranged from 7 to 14 feet. While the Verification studies are not specifically designed to generate aggregate data, the sampling techniques and testing procedures (Appendix A) are applicable to the aggregate evaluation.

The VSARS program required aerial and ground reconnaissance of the study area to collect additional information to verify conditions determined during the data review. Included in the 48 field station data stops was the collection of 21 samples for laboratory testing. Potential coarse and fine aggregate basin-fill samples were collected by channel sampling stream cuts or occassional man-made exposures. Potential crushed rock aggregate samples were obtained from exposures of fresh or slightly weathered material whenever possible. The weight of the samples collected range between 100 and 150 pounds. Hand samples, which generally did not exceed 5 pounds in weight, were collected for office analysis.

Identification of basin-fill materials in all field studies followed ASTM D2488-69 Description of Soils (Visual-Manual Procedure), and the Unified Soil Classification System (Appendix C). Rock identifications followed procedures described in the

Quarterly of the Colorado School of Mines and Standard Investigative Nomenclature of Constituents of Natural Mineral Aggregates (ASTM C294-69).

2.3 DATA ANALYSIS

Geologic and engineering criteria were used in the evaluation of potential aggregate sources within the study area. This was supplemented by laboratory analysis of selected samples during the Valley-Specific aggregate testing program (Table 1). Coarse aggregate is defined as plus 0.185 inch fine gravel to boulders basin-fill material. Fine aggregate is defined as minus 0.375 inch coarse to fine sand basin-fill material. While all laboratory tests supplied definitive information, the soundness, abrasion, and alkali reactivity results were considered the most critical in determining the use and acceptability of a potential aggregate source.

2.4 PRESENTATION OF RESULTS

Results of the study are presented in text form, tables, two 1:125,000 scale maps, and appendices. Drawing 1 presents the location of the 78 existing test data and supplemental Fugro data sites within the study area. Drawing 2 presents the location of all Fugro National aggregate resources sampled and tested field station sites and all potential basin-fill and rock aggregate sources within the valley area. In addition, these potential aggregate sources are classified according to proposed aggregate use and type (Section 2.5).

ASTM TEST	SAMPLE TYPE AND NUMBER OF TESTS		
	COARSE	FINE	ROCK
ASTM C-88; SOUNDNESS BY USE OF MAGNESIUM SULFATE	11	9	7
ASTM C-131; RESISTANCE TO ABRASION BY USE OF THE LOS ANGELES MACHINE	11		7
ASTM C-136; SIEVE ANALYSIS	11	9	
ASTM C-289; POTENTIAL REACTIVITY OF AGGREGATES (CHEMICAL METHOD)	2	2	3
ASTM C-127 AND C-128; SPECIFIC GRAVITY AND ABSORPTION	7	1	3

AGGREGATE TESTS
WHITE RIVER VALLEY
AGGREGATE RESOURCES STUDY, NEVADA

MX SITING INVESTIGATION
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TABLE 1

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Geologic unit symbols utilized in Drawing 2 relate to standard geological nomenclature whenever possible. Undifferentiated basin-fill and rock units were established primarily to accomodate accuracy of data and map scale and may contain deposits which could supply significant quantities of high quality materials. A conversion table to relate these geologic symbols to Fugro geologic unit nomenclature is contained in Appendix E.

All contacts which represent distinct boundaries between geologic units are shown as solid lines on Drawing 2. The contacts are dashed where the depicted data were extrapolated beyond the limits of the source data or where accuracy of the data may be questionable. Local small deposits of one geologic unit may be found in close association with a larger deposit of a different geologic unit. Due to the reconnaissance level of the field investigation or scale limitations, these smaller deposits could not be depicted on the aggregate resources map and have been combined with the more prevalent material. Similarly, potential aggregate source classifications are preliminary and may contain lesser amounts of material of another use or type. Therefore, all classification lines are dashed and delimit the best aggregate evaluations possible at this level of investigation. In cases of highly variable rock or basin-fill units and limited aggregate tests, boundaries could not be drawn and information is presented as point data on Drawing 2.

Appendices contain tables summarizing the basic data collected during Fugro National's supplemental field investigations, the

results of Fugro National's supplemental testing programs, existing test data gathered from various outside sources (Appendix A), an explanation of caliche development (Appendix B), the Unified Soil Classification System (Appendix C), photographs of typical aggregate sources within the study area (Appendix D), and a geologic unit cross reference table (Appendix E).

2.5 PRELIMINARY CLASSIFICATION OF POTENTIAL AGGREGATE SOURCES

A system was developed to preliminarily classify all potential aggregate sources in the study area. This classification is designed to present the best potential sources of coarse, fine, coarse and fine (multiple source), and crushed rock aggregate types within a Valley-Specific area (Drawing 2) based on potential aggregate use (Table 2). Concrete aggregate parameters are the principal consideration in this report as materials suitable for use as concrete aggregate are generally acceptable for use as road-base material. Therefore, the three classifications described below were based primarily on results of the abrasion, soundness, and alkali reactivity tests.

Class I — Potentially suitable concrete aggregate and road base material source. Coarse and crushed rock aggregates which either passed abrasion, soundness, and alkali reactivity tests or passed abrasion and soundness tests and were not tested for alkali reactivity; fine aggregates which either passed soundness and alkali reactivity tests or passed soundness tests and were not tested for alkali reactivity.

Class II — Possibly unsuitable concrete aggregate/potentially suitable road-base material source. Coarse, fine, and crushed rock aggregates which either failed the soundness and/or alkali reactivity tests or were classified only by field visual observations or other test data.

AGGREGATE CHARACTERISTIC[1]			AGGREGATE USE CLASSIFICATION		
			CLASS I	CLASS II	CLASS III
ABRASION RESISTANCE, PERCENT WEAR[2]			<50	<50	>50
SOUNDNESS, PERCENT LOSS[3]	COARSE AGGREGATE	$Na SO_4$	<12	>12	>12
		$Mg SO_4$	<18	>18	>18
	FINE AGGREGATE	$Na SO_4$	<10	>10	>10
		$Mg SO_4$	<15	>15	>15
POTENTIAL ALKALI REACTIVITY[4]			INNOCUOUS TO POTENTIALLY DELETERIOUS	DELETERIOUS	DELETERIOUS

1. AGGREGATE CHARACTERISTIC BASED ON STANDARD TEST RESULTS
2. ASTM C131 (500 REVOLUTIONS)
3. ASTM C88 (5 CYCLES)
4. ASTM C289

PRELIMINARY AGGREGATE CLASSIFICATION SYSTEM
VALLEY-SPECIFIC AGGREGATE RESOURCES STUDY

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

TABLE 2

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Class III <u>Unsuitable concrete aggregate or road base material source</u>. Coarse and crushed rock aggregates which failed abrasion test and were excluded from further testing Fine, and rarely, coarse aggregates composed of significant amounts of clay- and silt-sized particles.

Sources not specifically identified as Class I, II, or III from the three critical test results or clay- and silt-sized particle content, are designated as Class II sources. All classifications are preliminary with additional field reconnaissance, testing, and case history studies needed to confirm adequacy, delimit areal boundaries, and define exact physical and chemical characteristics.

The following publications/sources were used in defining the three use classifications:

(1) ASTM C33-74A Standard Specifications for concrete Aggregate,

(2) SSPWC Part II Construction Sections 200-1.1, 1.4, 1.5, and 1.7,

(3) Literature applicable to concrete aggregates,

(4) Industrial producers of concrete aggregates, and

(5) Consultants in the field of concrete aggregates.

3.0 GEOLOGIC SETTING

3.1 PHYSIOGRAPHY

The study area lies entirely within the Basin and Range physiographic province and has typical basin and range topography. Primary physiographic features are controlled by block faulting which has produced the horst and graben structure reflected in eroded uplifted mountains and downdropped alluvial filled basins characteristic of this region. Mountain ranges and valley basins generally trend north-south. Elevations within the valley range from about 6000 feet (1830 m) at the northern end of the study area to approximately 4400 feet (1340 m) near the southern terminus. Six mountain ranges bound the valley basin area. These are the Horse, Grant, Golden Gate, and Seaman ranges on the west and the Egan and North Pahroc ranges on the east (Drawing 2). Topographic relief between mountain ridges and basins is generally greatest along the eastern valley margin and varies from 1000 to 4000 feet (305 to 1220 m). Drainage is open within the main valley area (White River) with several reservoirs occupying the lower portions of the valley basin.

3.2 LOCATION AND DESCRIPTION OF GEOLOGIC UNITS

Paleozoic, Mesozoic, and Cenozoic rocks are found in bedrock highs and mountains within and adjacent to the study area (Drawing 2). Paleozoic sediments consist predominantly of massively to thinly bedded limestones and dolomites with interbedded sandstones, shales, and quartzites. These sediments are

located across the entire Valley-Specific area, and where not exposed in bedrock highs underlie younger geologic units.

Unconformably overlying Paleozoic rocks within the study region are Mesozoic deposits consisting predominantly of undifferentiated volcanic and intravolcanic sedimentary rocks. These rocks are principally composed of pyroclastics, mud flows, and breccias of andesitic composition.

Cenozoic rocks uncomformably overlie Paleozoic and Mesozoic units. These rocks consist predominantly of Tertiary intrusives, volcanics, and Quaternary alluvial sediments. Tertiary volcanic rocks are composed predominantly of a pyroclastic series of welded and nonwelded vitric and crystalline tuffs which range from mafic to rhyolitic in composition.

Quaternary alluvial deposits lie unconformably above all older units and consist primarily of Late Pliocene and Pleistocene alluvial fan, older lacustrine, stream channel, and terrace deposits. These units may reach a combined thickness of many thousands of feet in the basin center.

These geologic units have been grouped into seven rock and four basin-fill geologic units for use in discussing potential aggregate sources. The grouping of these units was based on similarities in physical and chemical characteristics and map scale limitations. The resulting units simplify discussion and presentation without altering the conclusions of the study.

3.2.1 Rock Units

Geologic rock units were grouped into the following seven categories (Drawing 2): quartzite (Qtz), dolomite (Do), limestone (Ls), carbonate rocks undifferentiated (Cau), sedimentary rocks undifferentiated (Su), basalt (Vb), and volcanic rocks undifferentiated (Vu).

3.2.1.1 Quartzite - Qtz

Quartzites are minor deposits within the study area but potentially may represent some of the best sources of crushed rock for concrete aggregate. Two lower Paleozoic quartzite deposits, the Prospect Mountain and Eureka quartzites, crop out in the Valley-Specific study area. A major deposit of the Prospect Mountain Quartzite is located at the southwestern corner of the study area within the Grant Range (Drawing 2). The formation consists of reddish brown, brown to white, thin to massively bedded, well indurated, fine grained quartzite with interbeds of less resistant quartzite, micaceous shale, pebble conglomerates, and arkosic layers.

The Eureka quartzite crops out as small units in the central portion of the valley area. The formation is thin, less than 500 feet (150 m) thick, and because of its close association with undifferentiated carbonates (Cau) is often mapped within this unit. Mapped units occur at the north end of the Golden Gate and Grant ranges and the south end of the Egan Range. The formation is a white or light gray, vitreous, fine to medium grained, massive orthoquartize. Interbedded sandstone and

dolomitic sandstone occur at the top and bottom of the formation.

3.2.1.2 Dolomite - Do

Dolomite is a high magnesium carbonate rock that is characteristically dark to medium gray, medium grained, hard, with well developed bedding and jointing with moderate to sparse amounts of chert. Principal formations that comprise the bulk of this unit are the lower Paleozoic Ely Springs, Laketown, Sevy, and Simonson dolomites. Major deposits are mapped in the Grant and Horse ranges just within the western border and the Egan Range on the east side of the study area.

3.2.1.3 Limestone -Ls

Limestone is a carbonate rock which is hard, durable, medium to massively bedded and a major cliff former within the study area. Mapped units represent upper Paleozoic formations including the Pogonip Group, Joanna, and undifferentiated Mississippian, Pennsylvanina, and Permian limestones. Rock units are typically medium to dark gray, fine to medium grained, fossiliferous limestones that are sparsely cherty, with well developed bedding and jointing. This unit is mapped chiefly in the northern portion of the study area, with major deposits occurring in the Egan, Grant, and Horse mountain ranges.

3.2.1.4 Carbonate Rocks Undifferentiated - Cau

Undifferentiated carbonate rocks are the most extensive of the sedimentary units mapped in the study area and include thick,

complex sequences of limestones and dolomites with thin interbeds of sandstone, shale, and siltstone. Individual units are not delineated separately due to map scale limitations and the highly interbedded nature of these units. Principle formations include the Devils Gate, Guilmette, and undifferentiated lower Paleozoic deposits. These rocks are typically light to dark gray in appearance, thinly to massively bedded, hard, cherty, fossiliferous, and are typically cliff formers. Mapped units occur extensively in the Egan, Grant, and Horse ranges in the northern half of the study area.

3.2.1.5 Sedimentary Rocks Undifferentiated - Su

Geologic formations mapped as undifferentiated sedimentary rocks include interbedded Paleozoic to Tertiary sandstone, shale, dolomite, limestone, and quartzite that may have been slightly metamorphosed in some areas. These deposits are generally poorly indurated and have complex thin to medium bedding. The highly interbedded nature of these units prevent separation into individual rock types (limestones, dolomites). Undifferentiated sedimentary rocks are not a major unit within the Egan Range and occur primarily as small outcrops, however, within the Horse and Grant mountain ranges along the western margin of the study area they comprise significant sedimentary deposits.

3.2.1.6 Basalt - Vb

Tertiary basalts mapped in the study area are characteristically dark gray to black, thick to massively bedded, dense, locally vesicular, and poorly jointed. Occasionally, interbeds of

volcanic agglomerate and pumice tuff are present. Basalts are of minor extent and occur primarily in and adjacent to the Golden Gate, Seaman, and North Pahroc ranges.

3.2.1.7 Volcanic Rocks Undifferentiated - Vu

Undifferentiated volcanic rocks comprise the most extensive rock unit in the study area. They range from Cretaceous to Pliocene in age and consist predominantly of welded and nonwelded pyroclastics of rhyolitic and andesitic composition. These units form the principal geologic units in the Seaman and North Pahroc ranges in the southern portion of the study area and crop out in major deposits within the Grant and Horse mountain ranges along the eastern border of the area.

The volcanics also include minor occurances of interbedded sedimentary rocks consisting of conglomerates, sandstones, and siltstones derived from volcanic sources. Individual rock units have not been delineated because of map scale limitations and complex but similar composition.

3.2.2 Basin-Fill Deposits

Four basin-fill units are mapped and labelled within the study area (Drawing 2). these consist of older lacustrine (Aol), alluvial fan (Aaf), stream channel and terrace (Aal), and undifferentated alluvial materials (Au). Recent playa deposits, a fifth basin-fill unit of limited areal extent, are also present in White River Valley. However, they are labelled as unsuitable aggregate sources and will not be discussed.

3.2.2.1 Older Lacustrine Deposits - Aol

Older lacustrine deposits were formed during late Pliocene/early Pleistocene time in response to a much wetter climate. These deposits are located at topographically higher elevations along the valley margins and are usually intermixed with or overlain by alluvial fan deposits. They range from coarse gravel to sand, silt, and clay. Classification of these deposits depends primarily on texture and clast composition. They occur principally in the lower portions of the White River Valley basin (Drawing 2).

3.2.2.2 Alluvial Fan Deposits - Aaf

Alluvial fans bordering the mountain fronts and extending out into the valley basins are the most extensive basin-fill deposit within the study area. They are typically heterogeneous to poorly stratified mixtures of boulders, cobbles, gravel, sand, silt, and clay that grade from very coarse-grained near the highland areas to fine-grained near the valley centers. Individual fan units contain poorly to well graded, angular to subangular particles and exhibit considerable lateral and vertical textural variation. Composition of the surrounding source rock strongly controls the textural properties of material found in alluvial fan deposits. Fan units formed at the base of carbonate or quartzitic rocks are characteristically coarse-grained, whereas fans developed from volcanic sources tend to be finer grained.

Caliche development in soils, a natural process of soil development in arid climates, ranges from none in younger fans to Stage III (Appendix B) in older units.

3.2.2.3 Stream Channel and Terrace Deposits - Aal

Stream channel and terrace deposits within the study area are associated with primary and secondary ephemeral streams. Secondary ephemeral streams commonly transect alluvial fan deposits and trend normal to the ranges toward the valley axis. There, they terminate in a through flowing primary drainage system that drains southward into Pahranagat Valley. Most are too small to be depicted on Drawing 2 and have been grouped with adjacent, more prominent units (i.e., alluvial fan, undifferentiated alluvium, older lacustrine deposits). These deposits vary from homogeneous to poorly stratified mixtures of sand, gravel, cobbles, and boulders near mountain fronts to sand, silt, and clay near valley centers.

3.2.2.4 Alluvial Deposits Undifferentiated - Au

Undifferentiated alluvial deposits consist of combinations of basin-fill units that were not delineated and mapped during the Verification program. Included in this group are alluvial fans, older lacustrine, stream channel, and stream terrace deposits. These alluvial deposits are homogeneous to stratified mixtures of boulders, cobbles, gravel, sand, silt, and clay derived from a wide range of rock types. Composition varies according to the characteristics of the individual units and the source rock type. Undifferentiated alluvial deposits are generally located

in the interior portions of the valley basins outside of the Verification study region (Drawing 2).

4.0 POTENTIAL AGGREGATE SOURCES

Based on the results of field visual observations and aggregate testing, potential basin-fill and rock sources were divided into three material types (i.e., coarse, fine, and crushed rock) and classified into one of the three use categories (Section 2.5). Basin-fill deposits tested in the study area may be placed within a multiple type category, (coarse and fine aggregate source). Coarse aggregate is defined as plus 0.185 inch (4.699) fine gravel to boulders and fine aggregate is defined as minus 0.375 inch (9.52) fine to coarse sand.

Classification boundaries (Drawing 2) of basin-fill aggregate sources were generalized and will require additional studies to accurately define their location. Boundaries of identified crushed rock sources are based on the areal map extent of the geologic formations tested (i.e., Prospect Mountain Quartzite, Guilmette Formation, Pogonip Group) and not on the aggregate geologic units (i.e., Cau, Do, Qtz) described in Section 3.2.1.

In the following discussion, the best potential coarse, fine, or crushed rock source within each Class I and Class II category is presented first; followed by sources with successively lower potential. This ranking of deposits is preliminary and based upon an analysis of all Fugro National and existing data.

4.1 BASIN-FILL SOURCES

4.1.1 Coarse Aggregate

4.1.1.1 Potentially Suitable Concrete and Road Base Material Sources - Class I

Extensive Class I coarse aggregate sources are located along the east side of White River Valley in alluvial fan units (Aafg) bordering Class I and II crushed rock sources in the Egan Range (Drawing 2). The alluvial fan units predominantly consist of poorly to moderately graded, medium dense to dense, homogeneous to crudely stratified, sandy gravel with subangular limestone and dolomite clasts. Laboratory test data indicate these deposits have acceptable abrasion and soundness values for Class I course material (Appendix A), however, alkali reactivity tests were not performed on the samples taken. Sieve analyses of these samples suggests that the fan deposits are weighted slightly toward the fine end. Content of fine aggregate material ranges from 5 to 45 percent in these deposits. Overburden averages about 1 meter and primarily consists of calichefied gravels (Stages II to III).

Generally good access to these deposits is provided by State Highway 38 and several unpaved roads that crisscross the area. Minability is considered good to excellent in these sources. Tentative boundaries were placed on identified sources wherever possible, however, additional field reconnaissance and testing will be necessary to accurately define the limits of these units and the point data sources.

Additional Class I coarse aggregate sources were identified in alluvial fan deposits (Aaf) east of the Grant ard Horse ranges and at the north end of the Golden Gate Range, in the west-central portion of the study area (Drawing 2). These deposits consist of medium dense, poorly graded, crudely stratified sandy gravel with angular to subangular, predominantly limestone clasts. Abrasion, soundness, and alkali test results for sources near the Horse and Grant ranges were acceptable for Class I sources. Abrasion and soundness losses were within Class I standards for the potential coarse aggregate source located at the northern end of the Golden Gate Range, however, alkali reactivity test results were not available. Sand comprises as much as 45 percent of the deposit. Sieve analysis of the samples is inconclusive, however, the data suggests that the coarse fraction is tends to be biased toward the finer grain sizes.

Overburden thickness averages less than 1 meter with caliche development ranging from Stage II to III. Boundaries of these units could not be drawn due to the limited scope of the field reconnaissance and testing program. Access to these deposits is provided by numerous unpaved roads that crisscross the area and minability is considered good to excellent in these sources.

Older lacustrine deposits (Aolg) were identified as a Class I coarse aggregate source within undifferentiated alluvial units (Au) northwest of the North Pahroc Range in the southern portion of the study area. The unit consists of moderately graded,

dense, crudely stratified sandy gravel primarily composed of limestone clasts. Abrasion and soundness losses are well within Class I standards. Alkali reactivity tests were not made on this source. Sieve analysis indicates that the coarse fraction is heavily weighted toward small gravel sizes and sands comprise as much as 40 percent of the deposit. Overburden thickness averages about 1 meter. Boundaries of this source were not delineated due to the limited scope of this investigation and will require additional field reconnaissance and testing to accurately define. Access is provided by State Highway 38, (unpaved portion), and the minability of this deposit is considered good to excellent.

Extensive Class I coarse aggregate deposits were also identified in older lacustrine deposits (Aolg) at the southeastern terminus of the study area and within Pahranagat Valley. These deposits consist of moderately well graded, medium dense to dense, stratified sandy gravels composed primarily of carbonate clasts. Test results were positive, with acceptable losses in abrasion and soundness (see report FN-TR-37a, section 4.1.1.1, and Appendix A for information). Sieve analysis suggests that the deposit may be deficient in fine size gravel gradations. Sand comprises less than 25 percent of this deposit with overburden thickness ranging from 1 to 5 meters (averaging 2 to 3 meters). The sand has not been tested and may provide an additional source of fine material.

Field observations suggest that additional sources of Class I coarse aggregate may be located near the rock/alluvium contact of most of the Class I and/or Class II carbonate rock units bordering the valley basin.

4.1.1.2 Possibily Unsuitable Concrete Aggregate/ Potentially Suitable Road-Base Material Sources - Class II

A specific Class II coarse aggregate source was identified in an alluvial fan deposit (Aafs - Verification Studies) located at the southern end of Horse Range (Drawing 2). This deposit consists of moderately well graded, dense, crudely stratified, sandy gravel with subangular clasts derived predominantly from intermediate volcanics of varying composition. Abrasion losses were within Class I standards, however, unacceptable soundness losses occurred during testing. Sieve analysis indicates that the gravel fraction tends to be skewed toward the coarser grains. Boundaries of this source could not be delineated and will require additional field reconnaissance and testing for accurate location. Approximately two meters of calichefied overburden (Stage III) covers this deposit. Access to this source is good and is provided by unpaved roads and numerous four-wheel-drive trails in this region. Minability is considred good to excellent.

Additional Class II coarse aggregate sources should be available from alluvial fan units (Aaf) located near the rock/alluvium contact of most Class I and Class II crushed rock sources. The

minability and access to these sources should generally be good to excellent.

4.1.1.3 Unsuitable Concrete Aggregate or Road Base Material Sources - Class III

No unsuitable coarse aggregate sources were identified in the White River Valley region during Valley Specific studies.

4.1.2 Fine Aggregate

4.1.2.1 Potentially Suitable Concrete Aggregate and Road-Base Material Sources - Class I

The only Class I fine aggregate source identified in White River Valley occurred as part of a multiple source type alluvial fan deposit (Aafs) at the north end of the Golden Gate Range (Drawing 2). This source consists of medium dense, moderately graded, and crudely stratified sandy gravel (information regarding the Class I, coarse fraction is discussed in section 4.1.1.1). Sieve analysis of the sand fraction indicates the deposit is slightly biased toward the coarser grains. A potentially deleterious silt- and clay-sized material content of approximately 20 percent is present in this deposit. Tests for alkali reactivity were not made on this sample. Overburden thickness is less than 1 meter and the minability and access to this source is considered good to excellent.

The central valley location of this source, provides good to excellent access and the minability is considered very good.

No other Class I fine aggregate sources were specifically identified in the study area. Based on field observations,

additional Class I sources may be located in alluvial fan units (Aaf) bordering most of the Classes I and II carbonate rocks (Cau) surrounding the valley margin and in older lacustrine sands (Aols) located in the central valley area (Drawing 2). The access and minability of potential fine aggregate sources in these alluvial fan and older lacustrine units should be good to excellent.

4.1.2.2 Possibly Unsuitable Concrete Aggregate/Potentially Suitable Road-Base Materials Sources - Class II

Specific Class II fine aggregate sources were identified in alluvial fan units (Aafs) and older lacustrine (Aols) deposits that received sediments from the Egan Range in the central portion of the study area (Drawing 2). These deposits consist of moderately graded, medium dense, crudely stratified, gravelly sand. Gravel comprises about 20 percent of the sieved samples with clasts primarily consisting of carbonates and volcanics derived from the nearby mountain range. Unacceptable soundness losses for the three samples tested ranged from 21 to 31 percent. Alkali reactivity tests were not run on these samples. Testing of fine aggregate material from coarse aggregate multiple sources identified in the same alluvial fan complex (Aafg) gives similar negative results for the soundess evaluation. Fine aggregate material in the multiple sources comprises from 5 to 45 percent of these deposits. Sieve analyses of the fine aggregate from all of these samples indicates that these sources tend to be slightly biased toward the coarse fraction. Field observations suggest that the overburden

averages less than 1 meter and the minability of these units should be excellent. Several unpaved roads provide good access to the source areas.

Addition of crushed Class I coarse material to the fine aggregate fraction of the multiple type sources during processing and crushing may result in this fraction becoming suitable as a Class I aggregate source.

Boundaries of Class II fine aggregate sources could not be delineated on Drawing 2 at this level of investigation and will require additional field reconnaissance and testing to accurately delineate. Additional sources of Class II fine aggregate are probably available in almost all alluvial fan units bordering Classes I and II crushed rock sources.

4.1.2.3 Unsuitable Concrete Aggregate or Road-Base Material Sources - Class III

Class III fine aggregate sources are located in the valley basins and are predominantly composed of older lacustrine (Aol) deposits (Drawing 2). These sediments are typically comprised of interbedded and stratified, moderately dense, fine sand, silt, and clay.

4.2 CRUSHED ROCK SOURCES

4.2.1 Potentially Suitable Concrete Aggregate and Road-Base Material Sources - Class I

Class I crushed rock sources are widely distributed throughout the study area (Drawing 2). The most extensive deposits occur the Horse, Grant, and Seaman ranges in west-central White River

Valley and consist primarily of limestones and dolomites from the Guilmette Formation (Cau). Tests were completed on the limestone and a minor sandstone member of this unit. Field observations and laboratory testing (Appendix A) on these two members of the Guilmette Formation indicate that splitting characteristics are favorable for crushing and abrasion and soundness losses are moderate to low (Table 2). Acceptable reactivity tests were obtained from the sandstone unit and although alkalai reactivity tests have not been completed on the limestone, field observations suggest that amorphous silica is relatively minor within this unit. This formation also forms the principle Class I material of the White Pine and Egan ranges at the north end of the region and is the major crushed rock source in the North Pahranagat Mountains at the south end of the study area (Drawing 2).

Access to this formation is particularly good where bedrock highs and small ranges cropout in the central valley region. Minability should be good to excellent.

Although relatively minor in areal extent, the Eureka Quartzite (Qtz) crops out in small rock exposure over much of the central portion of the study area and forms an important Class I crushed rock source. The formation is exposed within the Grant and Horse ranges on the west side of the valley, in the Egan Range along the eastern boundary, and at the north end of the Golden Gate Range in the central portion of the valley. The Eureka Quartzite is characteristically a fine-grained extremely hard

and favorably jointed rock. Abrasion and soundness tests are within Class I standards, however, alkali reactivity tests have not been performed. Access to this formation is generally very good and is provided by paved and unpaved roads. Minability should generally be good to excellent.

Two types of Class I volcanic rocks (Vu) were identified within the study area. Andesitic volcanic rocks at the northern end of the valley near the junction of U.S. Highway 6 and State Highway 38 and rhyolitic tuffs at the north end of the Grant Range on the west side of White River Valley. Although, not considered a primary source of Class I crushed rock due to lateral and vertical lithologic variations, acceptable test results indicate that volcanic rocks of these compositions could make potentially suitable crushed rock sources in areas where unit boundaries can be defined.

4.2.2 Possibly Unsuitable Concrete Aggregate/Potentially Suitable Road-Base Material Class II

A welded ash flow tuff of rhyolitic composition (Vu) was identified as a Class II crushed rock source at the north end of the Golden Gate Range in the southwestern portion of the valley region (Drawing 2). The rock unit passed the abrasion test for Class I standards but displayed excessive soundness losses and was accordingly ranked as a Class II source. Volcanic rocks of this composition should make a suitable crushed rock source for road base material. Because of the vertical and lateral lithologic variability of these volcanic rocks, other portions of

this unit could be acceptable as Class I rock sources or rejected as Class III material. Therefore, boundaries of this Class II crushed rock source have not been drawn and will require additional field reconnaissance and testing to delineate. Access to this source is good to excellent because of its central valley position. The minability of this deposit is considered very good.

No other Class II crushed rock aggregate sources were specifically identified from the laboratory testing program. Extensive rock units indicated on Drawing 2 as Class II crushed rock sources were classified by field visual observations or have not been examined during reconnaissance studies. Paleozoic carbonates (Cau, Do, Ls) and Mesozoic and Tertiary undifferentiated (Vu) volcanics comprise the predominant rock types in this classification.

4.2.3 Unsuitable Concrete Aggregate or Road-Base Material Sources - Class III

No Class III crushed rock sources were identified within the White River Valley study area during this investigation.

5.0 CONCLUSIONS

Results of the valley-specific aggregate investigation indicate that potentially good to high quality (Classes I and II) basin-fill and rushed rock aggregate sources are present within the White River Valley Specific study area to meet construction requirements of the MX system (Drawing 2).

5.1 POTENTIAL BASIN-FILL AGGREGATE SOURCES

5.1.1 Coarse Aggregate

Major Class I coarse aggregate deposits listed in order of potential suitablity, have been identified within the following areas:

1. alluvial fan deposits west of the Egan Range in east-central Dry Lake Valley,
2. alluvial fans bordering the Grant and Horse ranges in the west-central portion of the valley,and
3. in older lacustrine sediments in the southern section of White River Valley and northern Pahranagat Valley, south of the study area.

Field observations indicate additional sources of Class I coarse aggregate may be available in alluvial fan deposits adjacent to the rock/alluvium contact of Classes I and II crushed rock sources.

Potential Class II coarse aggregate sources are widespread and extensive in the study area. Although boundaries of specific deposits could not be delineated, they are typically located within alluvial fans flanking Class I and/or Class II rock sources.

5.1.2 Fine Aggregate

While most coarse aggregate sources will supply quantities of fine aggregate either from the natural deposits or during processing, several fine aggregate sources were sampled and tested. Class I fine aggregate deposits were identified in alluvial fans at the north end of the Golden Gate Range (multiple source). Based on field observations, further field reconnaissance will be required to identify and delineate additional potential Class I fine aggregate sources that may exist in alluvial fan units derived from Classes I and II rock sources.

Potential Class II fine aggregate sources are widespread and extensive in the study area. Specific Class II fine aggregate deposits are located in alluvial fans along the central and southern sections of the Egan Range and although boundaries could not be delineated these sources typically occur basinward of most Class I and Class II coarse aggregate deposits and/or rock exposures.

5.2 POTENTIAL CRUSHED ROCK AGGREGATE SOURCES

Class I crushed rock sources exist in most sections of the study area. The most suitable deposits and their corresponding locations are listed below:

1. Guilmette Formation - Widespread deposits in all ranges within the valley-specific area.
2. Eureka Quartzite - Central Valley-Specific study area (Egan, Grant, and Horse ranges).
3. Undifferentiated Volcanics - West central Valley-Specific study area (Horse Range).

Small bedrock exposures comprised of Class I carbonates and quartzites which cropout in the central valley area would be excellent sources of Class I crushed rock material because of their central location and good to excellent access and minability. Additionally, Class I crushed rock sources, exposed within the Egan, Grant, and Horse ranges, because of their close proximity to the valley basin and good to excellent minability, could provide crushed rock material for much of the central valley area.

Undifferentiated volcanics and limited sedimentary units are widely distributed throughout the study area and comprise most of the Class II crushed rock sources delineated on Drawing 2.

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APPENDIX A

Fugro National Field Station and Supplementary Test Data and Existing Test Data Summary Tables - White River Valley

EXPLANATION OF FUGRO NATIONAL FIELD STATION AND SUPPLEMENTARY TEST DATA

Fugro National field stations were established at locations throughout the Valley-Specific study area where detailed descriptions of potential basin-fill or rock aggregate sources were recorded (Drawing 1). All field observations and laboratory test data on samples collected at selected stations are presented in Table A-1. Data entries record conditions at specific field station locations that have been generalized in the text and Drawing 2. Detailed explanations for the column headings in Table A-1 are as follows:

Column Heading	Explanation
Map Number	This sequentially arranged numbering system was established to facilitate the labelling of Fugro National field station locations and existing data sites on Drawing 1 and to list the correlating information on Tables A-1 and A-2 in an orderly arrangement.
Field Station	Fugro National field station data are comprised of information collected during: o The Valley-Specific Aggregate Resources Study; sequentially numbered field stations were completed by two investigative teams (A and B). The Dry Lake Candidate Deployment Area (DLCDP) designation is obsolete. The presently understood study area consists of Dry Lake, Muleshoe, Delamar, and Pahroc valleys. o The general aggregate investigation in Nevada (NV); R and H indicate ground and aerial reconnaissance stops, respectively. o The Verification study in Dry Lake (DL), Muleshoe (MS), Delamar (DM), and Pahroc

Column Heading	Explanation
Field Station (cont.)	(P) valleys; trench data (T) were restricted to information below the soil horizon (1 to 2 meters).
Location	Lists major physiographic or cultural feature in/or near which field stations or existing data sites are situated.
Geologic Unit	Generalized basin-fill or rock geologic units at field station or existing data locations. Thirteen classifications, emphasizing age and lithologic distinctions were developed from existing geologic maps to accomodate map scale of Drawing 2.
Material Description	Except in cases where soil or rock samples were classified on laboratory results, the descriptions are based on field visual observations utilizing the Unified Soil Classification System (See Appendix C for detailed USCS information).
Field Observations	
Boulders and/or Cobbles, Percent	The estimated percentage of boulders and cobbles is based on an appraisal of the entire deposit. Cobbles have an average diameter between 3 and 12 inches (8 and 30 cm); boulders have an average diameter of 12 inches (30 cm) or more.
Gravel	Particles that will pass a 3-inch (76 mm) and are retained on No. 4 (4.75 mm) sieve.
Sand	Particles passing No. 4 sieve and retained on No. 200 (0.075 mm) sieve.
Fines	Silt or clay, soil particles passing No. 200.
Plasticity (Index)	Plasticity index is the range of water content, expressed as percentage of the weight of the oven-dried soil, through which the soil is plastic. It is defined as the liquid limit minus the plastic limit. Field classification followed standard descriptions and their ranges are as follows:

None	- Nonplastic (NP)	(PI, 0 - 4)
Low	- Slightly plastic	(PI, 4 - 15)
Medium	- Medium plastic	(PI, 15 - 30)
High	- Highly plastic	(PI, > 31)

Column Heading	Explanation
Hardness	A field test to identify materials that are soft or poorly bonded by estimating their resistance to impact with a rock hammer; classified as either soft, moderately hard, hard, or very hard.
Weathering	Changes in color, texture, strength, chemical composition or other properties of rock outcrops or rock particles due to the action of weather; field classified as either fresh or slight(ly) moderate(ly) or very weathered.
Deleterious Materials	Substances potentially detrimental to concrete performance that may be present in aggregate; includes organic impurities, low density material, (ash, vesicules, pumice, cinders), amorphous silica (opal, chert, chalcedony), volcanic glass, caliche coatings, clay coatings, mica, gypsum, pyrite, chlorite, and friable materials, also, aggregate that may react chemically or be affected chemically by other external influences.
Laboratory Test Data	
Sieve Analysis (ASTM C 136)	The determination of the proportions of particles lying within certain size ranges in granular material by separation on sieves of different size openings; 3-inch, 1 1/2-inch, 3/4-inch, 3/8-inch, No. 4, No. 8, No. 16, No. 30, No. 50, No. 100 and No. 200.
No. 8, No. 50	Asterisked entries used No. 10 and No. 40 sieves, respectively.
Abrasion Test (ASTM C 131)	A method for testing abrasion resistance of an aggregate by placing a specified amount in a steel drum (the Los Angeles testing machine), rotating it 500 times, and determing the material worn away.
Soundness Test (ASTM C 88) CA, FA	CA = Coarse Aggregate FA = Fine Agregate The testing of aggregates to determine their resistance to disintegration by saturated solutions of magnesium sulfate. It furnishes information helpful in judging the soundness of aggregates subject to weathering action, particularly when adequate

Column Heading	Explanation
	information is not available from service records of the material exposed to actual weathering conditions.
Specific Gravity and Absorption (ASTM C 127 and 128)	Methods to determine the Bulk Specific Gravity, Bulk SSD Specific Gravity (Saturated - Surface Dry Basis), and Apparent Specific Gravity and Absorption as defined in ASTM E12-70 and ASTM C 125, respectively.
Alkali Reactivity (ASTM C 289)	This method covers chemical determination of the potential reactivity of an aggregate with alkalies in portland cement concrete as indicated by the amount of reaction during 24 h at 80 C between 1 N sodium hydroxide solution and aggregate that has been crushed and sieved to pass a No. 50 (300-μm) sieve and be retained on a No. 100 (150-μm) sieve.
Aggregate Use	I = Class I; potentially suitable concrete aggregate and road-base material source. II = Class II; possibly unsuitable concrete aggregate/potentially suitable road-base material source. III = Class III; unsuitable concrete aggregate or road base material source. c = coarse aggregate f = fine aggregate f/c = fine and coarse aggregate cr = crushed rock All sources not specifically identified as Class I, II, or III from the abrasion, soundness, or alkali reactivity tests or the content of clay- and silt-sized particles, are designated as Class II sources.

MAP NUMBER	FIELD STATION	LOCATION	GEOLOGIC UNIT	MATERIAL DESCRIPTION	USCS SYMBOL	BOULDERS AND/OR COBBLES, PERCENT	DISTRIBUTION OF MATERIAL FINER THAN COBBLES, PERCENT			PLASTICITY
							GRAVEL	SAND	FINES	
1	WRNCDP-A1	White River Valley	Aafg	Silty Gravelly Sand	SM					Nc
2	WRNCDP-A2	White River Valley	Aafg	Sandy Gravel	GP					Lc
3	WRNCDP-A3	Shingle Pass	Vu	Welded Ash						
4	WRNCDP-A4	White River Valley	Aals	Gravelly Sand	SP-SM					No
5	WRNCDP-A5	Fox Mountains	Aols	Gravelly Sand	SP-SM	T				No
6	WRNCDP-A6	White River Valley	Qtz	Quartzite						
7	WRNCDP-A7	White River Valley	Aols	Silty Sand	SM	0	5	75	20	Nc
8	WRNCDP-A8	White River Valley	Su	Conglomerate						
9	WRNCDP-A9	Timber Mountains Pass	Vu	Ash Flow Tuff						
10	WRNCDP-A12	White River Valley	Vu	Welded Ash Flow						
11	WRNCDP-A13	White River Valley	Vu	Rhyolite						
12	WRNCDP-A14	White River Valley	Ls	Limestone						

FIELD OBSERVATIONS						SIEVE ANALYSIS, PERCENT PASSING (ASTM C 136)									
BUTION OF AL FINER COBBLES. RCENT		PLASTICITY	HARDNESS	WEATHERING	DELETERIOUS MATERIALS	3"	1½"	¾"	⅜"	NO. 4	NO. 8	NO. 16	NO. 30	NO. 50	NO. 10
SAND	FINES														
		None			8% Devitrified Rhyolite, Chert, Caliche				100	80.3	69.9	60.7	51.1	38.6	28.
		Low			Caliche Coatings	93.4	82.4	56.5	34.9	26.2					
			Mod. Hard	Slight	Volcanic Glass, Pumice										
		None			<5% Chert, Friable Materials				100	86.1	70.1	52.2	33.1	15.3	7.
		None			60% Weathered Intermediate Volcanics				100	83.0	73.6	61.1	42.5	22.5	12.
			Hard	Moderate	None										
5	20	None			Caliche Coatings										
			Mod. Hard	Moderate	10% Chert										
			Hard	Slight	Volcanic Glass										
			Mod. Hard	Moderate	Volcanic Glass, Low Density Materials										
			Mod. Hard	Moderate	Devitrified Glass										
			Hard	Slight	None										

LABORATORY TEST DATA

TM C 136)				ABRASION TEST (ASTM C 131)	SOUNDNESS TEST (ASTM C 88)		SPECIFIC GRAVITY AND ABSORPTION (ASTM C 127 AND C 128)								ALKALI REACTIVITY (ASTM C 289)	
							COARSE AGGREGATE				FINE AGGREGATE					
							SPECIFIC GRAVITY			PERCENT ABSORPTION	SPECIFIC GRAVITY			PERCENT ABSORPTION		
	NO. 50	NO. 100	NO. 200	PERCENT WEAR	PERCENT LOSS CA	PERCENT LOSS FA	BULK	BULK SSD	APPARENT		BULK	BULK SSD	APPARENT		CA	FA
1	38.6	28.5	19.1			20.53										
				21.2	2.43		2.74	2.76	2.80	0.83						
	15.3	7.9	5.2			30.50										
	22.5	12.8	8.2			30.97										
				28.7	2.30										Innocuous (Borderline)	
				34.6	23.6											

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ABSORPTION (C 128) FINE AGGREGATE CIFIC GRAVITY K	BULK SSD	APPAR-ENT	PERCENT ABSORPTION	ALKALI REACTIVITY (ASTM C 289) CA	FA	AGGREGATE USE
						IIf
						Ic
						IIcr
						IIf
						IIf
				Innocuous (Borderline)		Icr
						IIf
						IIcr
						IIcr
						IIcr
						IIcr
						IIcr

FUGRO NATIONAL FIELD STATION
AND SUPPLEMENTARY TEST DATA
WHITE RIVER VALLEY, NEVADA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE BMO

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FUGRO NATIONAL, INC.

MAP NUMBER	FIELD STATION	LOCATION	GEOLOGIC UNIT	MATERIAL DESCRIPTION	USCS SYMBOL	FIE				
						BOULDERS AND/OR COBBLES, PERCENT	DISTRIBUTION OF MATERIAL FINER THAN COBBLES, PERCENT			PLASTICITY
							GRAVEL	SAND	FINES	
13	WRNCDP-A15	White River Valley	Ls	Limestone						
14	WRNCDP-A16	White River Valley	Aolg	Gravel	GP					None
15	WRNCDP-A17	White River Valley	Ls	Limestone						
16	WRNCDP-A18	Sawmill Canyon	Ls	Limestone						
17	WRNCDP-A19	Sawmill Canyon	Aafg	Sandy Gravel	GP					None
18	WRNCDP-A20	The Cove	Vu	Andesite						
19	WRNCDP-A21	White Knoll	Ls	Limestone						
20	WRNCDP-A22	White River Valley	Aafs	Gravelly Sand	SP-SM	T	30	60	10	Low
21	WRNCDP-A23	White River Valley	Aafg	Sandy Gravel	GP					None
22	WRNCDP-A24	Sheep Pass Canyon	Ls	Limestone						
23	WRNCDP-A25	Nine Mile Canyon	Ls	Limestone						
24	WRNCDP-A26	White River Valley	Aafg	Sandy Gravel	GP					None
25	WRNCDP-A27	Shingle Pass	Aafg	Sandy Gravel	GP					None

FIELD OBSERVATIONS														
PLASTICITY	HARDNESS	WEATHERING	DELETERIOUS MATERIALS	SIEVE ANALYSIS, PERCENT PASSING (ASTM C 136) 3"	1½"	¾"	⅜"	NO. 4	NO. 8	NO. 16	NO. 30	NO. 50	NO. 100	
	Hard	Very	<5% Chert											
None			12% Chert	100	34.2	8.6	6.0	4.5	3.7	3.0	2.3	1.7	1.5	
	Very Hard	Fresh	None											
	Mod. Hard	Very	<5% Chert											
None			Caliche Coatings	100	89.1	78.1	59.7	40.4						
	Very Hard	Slight	<5% Volcanic Glass											
	Hard	Slight	Chert											
Low			<5% Chert											
None			4% Altered Volcanics, Caliche Coatings	94.2	87.9	79.0	62.9	44.6	34.6	24.3	18.2	13.8	10.0	
	Hard	Slight	None											
	Hard	Slight	None											
None			Caliche Coatings	100	93.4	78.7	57.4	38.8						
None			None	98.2	81.6	67.6	52.6	42.4	36.4	30.8	24.3	15.0	7.8	

LABORATORY TEST DATA

M C 136)			ABRASION TEST (ASTM C 131)	SOUNDNESS TEST (ASTM C 88)		SPECIFIC GRAVITY AND ABSORPTION (ASTM C 127 AND C 128)								ALKALI REACTIVITY (ASTM C 289)	
						COARSE AGGREGATE				FINE AGGREGATE					
						SPECIFIC GRAVITY			PERCENT ABSORPTION	SPECIFIC GRAVITY			PERCENT ABSORPTION		
NO. 50	NO. 100	NO. 200	PERCENT WEAR	PERCENT LOSS CA	PERCENT LOSS FA	BULK	BULK SSD	APPARENT		BULK	BULK SSD	APPARENT		CA	FA
			25.7	1.9		2.69	2.70	2.71	0.31						
1.7	1.5	1.3	21.9	1.14	9.36	2.56	2.60	2.66	1.59						
			26.3	4.43		2.70	2.72	2.76	0.83						
			20.9	2.80		2.47	2.52	2.60	2.03						Potentially Deleterious
13.8	10.0	4.5	28.4	6.52	17.25										
			24.3	2.64		2.70	2.72	2.76	0.74						
15.0	7.8	4.3	25.4	4.12	17.46										

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SPECIFIC GRAVITY AND ABSORPTION (ASTM C 127 AND C 128)								ALKALI REACTIVITY (ASTM C 289)		AGGREGATE USE
COARSE AGGREGATE				FINE AGGREGATE						
SPECIFIC GRAVITY			PERCENT ABSORPTION	SPECIFIC GRAVITY			PERCENT ABSORPTION			
ULK	BULK SSD	APPAR-ENT		BULK	BULK SSD	APPAR-ENT		CA	FA	
.69	2.70	2.71	0.31							IIcr
.56	2.60	2.66	1.59							IIc If
										IIcr
										IIcr
.70	2.72	2.76	0.83							Ic IIf
.47	2.52	2.60	2.03						Potentially Deleterious	Icr
										IIcr
										IIf/c
										Ic IIf
										IIcr
										IIcr
.70	2.72	2.76	0.74							Ic IIf
										Ic IIf

FUGRO NATIONAL FIELD STATION
AND SUPPLEMENTARY TEST DATA
WHITE RIVER VALLEY, NEVADA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

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FUGRO NATIONAL, INC.

MAP NUMBER	FIELD STATION	LOCATION	GEOLOGIC UNIT	MATERIAL DESCRIPTION	USCS SYMBOL	FI				
						BOULDERS AND/OR COBBLES, PERCENT	DISTRIBUTION OF MATERIAL FINER THAN COBBLES, PERCENT			PLASTICITY
							GRAVEL	SAND	FINES	
26	WRNCDP-B1	White River Valley	Aalg	Gravelly Sand	SM	0	20	65	15	Low
27	WRNCDP-B2	White River Valley	Qtz	Quartzite						
28	WRNCDP-B3	White River Valley	Aafg	Sandy Gravel	GP	10	60	25	15	Low
29	WRNCDP-B6	White River Valley	Aalg	Sandy Gravel	GP-GM					None
30	WRNCDP-B9	White River Valley	Vb	Basalt						
31	WRNCDP-B10	White River Valley	Aafs	Clayey Sandy Gravel	GC					Low
32	WRNCDP-B11	White River Valley	Aafg	Sandy Gravel	GP					None
33	WRNCDP-B12	White River Valley	Aafs	Gravelly Sand	SP	5	30	70	T	None
34	WRNCDP-B13	White River Valley	Aafg	Sandy Gravel	GP					None
35	WRNCDP-B14	White River Valley	Ls	Limestone						
36	WRNCDP-B15	White River Valley	Aals	Sandy Gravel	GP					None
37	WRNCDP-B16	White River Valley	Ls	Limestone						
38	WRNCDP-B17	White River Valley	Vu	Perlite						

FIELD OBSERVATIONS				SIEVE ANALYSIS, PERCENT PASSING (ASTM C 136)										
PLASTICITY	HARDNESS	WEATHERING	DELETERIOUS MATERIALS	3"	1½"	¾"	⅜"	NO. 4	NO. 8	NO. 16	NO. 30	NO. 50	NO. 100	NO. 200
Low			56% Chert and Jaspen											
	Very Hard	Slight	None											
Low			Volcanic Glass											
None			<5% Caliche Nodules	100	92.9	83.7	69.2	51.8	42.2	32.4	22.8	13.5	9.0	6.3
	Hard	Slight	Vesicles											
Low			Caliche Nodules	100	97.3	85.6	68.5	52.8	41.6	35.0	31.2	28.1	25.3	20.5
None			8% Caliche Nodules	90.1	80.9	59.8	37.7	22.8						
None			16% Low Density Materials											
None			30% Friable and Low Density Materials	66.6	48.1	35.1	28.7	24.4						
	Very Hard	Slight	None											
None			Low Density Materials	100	99.1	85.8	67.9	34.6	25.5	19.2	13.6	8.6	6.0	3.9
	Hard	Slight	None											
	Hard	Slight	30 to 40% Volcanic Glass											

LABORATORY TEST DATA

(C 136)			ABRASION TEST (ASTM C 131)	SOUNDNESS TEST (ASTM C 88)		SPECIFIC GRAVITY AND ABSORPTION (ASTM C 127 AND C 128)								ALKALI REACTIVITY (ASTM C 289)	
						COARSE AGGREGATE				FINE AGGREGATE					
						SPECIFIC GRAVITY			PERCENT ABSORPTION	SPECIFIC GRAVITY			PERCENT ABSORPTION		
NO. 50	NO. 100	NO. 200	PERCENT WEAR	PERCENT LOSS CA	PERCENT LOSS FA	BULK	BULK SSD	APPAR-ENT		BULK	BULK SSD	APPAR-ENT		CA	FA
			38.8	8.2											
13.5	9.0	6.3	27.0	10.96	24.85	2.53	2.59	2.68	2.14					Innocuous	Innocuous (Borderline)
28.1	25.3	20.5	20.5	5.36	11.68					2.64	2.68	2.73	1.17		
			30.3	2.96		2.66	2.69	2.74	1.15						
			33.3	19.74											
			29.1	1.60		2. 0	2.71	2.71	0.20						
8.6	6.0	3.9	26.1	9.68	23.87	2.68	2.71	2.78	1.28					Innocuous	Potentially Deleterious

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AVITY AND ABSORPTION 127 AND C 128)					ALKALI REACTIVITY (ASTM C 289)		AGGREGATE USE
	FINE AGGREGATE						
	SPECIFIC GRAVITY						
PERCENT ABSORPTION	BULK	BULK SSD	APPAR-ENT	PERCENT ABSORPTION	CA	FA	
							IIf/c
							Icr
							IIc/f
.14					Innocuous	Innocuous (Borderline)	Ic IIf
							IIcr
	2.64	2.68	2.73	1.17			Ic/f
.15							Ic
							IIf/c
							IIc
.20							Icr
.28					Innocuous	Potentially Deleterious	Ic IIf
							IIcr
							IIcr

FUGRO NATIONAL FIELD STATION AND SUPPLEMENTARY TEST DATA WHITE RIVER VALLEY, NEVADA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

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FUGRO NATIONAL, INC.

MAP NUMBER	FIELD STATION	LOCATION	GEOLOGIC UNIT	MATERIAL DESCRIPTION	USCS SYMBOL	BOULDERS AND/OR COBBLES, PERCENT	DISTRIBUTION OF MATERIAL FINER THAN COBBLES, PERCENT			
							GRAVEL	SAND	FINES	
39	WRNCDP-B18	Horse Range Mountains	Vu	Rhyolite						
40	WRNCDP-B19	Horse Range Mountains	Su	Conglomerate						
41	WRNCDP-B20	Horse Range Mountains	Su	Siltstone						
42	WRNCDP-B21	White River Valley	Aafg	Silty Sandy Gravel	GM	5	45	35	15	Lo
43	WRNCDP-B22	White River Valley	Aals	Gravelly Sand	SP	T	45	55	T	No
44	WRNCDP-C1	W. White River Valley	Aafg	Sandy Gravel	GP	T	55	40	5	No
45	WRNCDP-C2	E. White River Valley	Aafg	Sandy Gravel	GP	T	55	37	8	Lo
46	WRNCDP-C3	White River Valley	Qtz	Quartzite						
47	WRNCDP-C4	Horse Range	Do	Dolomite						
48	WRNCDP-C5	Golden Gate Range	Ls	Limestone						
49	NV-R-69	White Pine Range	Cau	Limestone						
50	NV-R-70	White Pine Range	Vu	Rhyolite						

FIELD OBSERVATIONS						SIEVE ANALYSIS, PERCENT PASSING (ASTM C 136)									
TION OF FINER BBLES. ENT		PLASTICITY	HARDNESS	WEATHERING	DELETERIOUS MATERIALS										
	FINES					3"	1½"	¾"	⅜"	NO. 4	NO. 8	NO. 16	NO. 30	NO. 50	NO. 100
			Hard	Slight	Friable Materials										
			Hard	Moderate	Friable Materials, Mica										
			Mod. Hard	Moderate	None										
	15	Low			30% Caliche Nodules										
	T	None			Caliche Coatings										
	5	None			None										
	8	Low			None										
			Very Hard	Slight	None										
			Hard	Slight	<5% Chert										
			Hard	Slight	<5% Chert										
					<5% Chert, Argillaceous										
					Glassy										

LABORATORY TEST DATA

TM C 136)				ABRASION TEST (ASTM C 131)	SOUNDNESS TEST (ASTM C 88)		SPECIFIC GRAVITY AND ABSORPTION (ASTM C 127 AND C 128)								ALKALI REACTIVITY (ASTM C 289)	
							COARSE AGGREGATE				FINE AGGREGATE					
							SPECIFIC GRAVITY			PERCENT ABSORPTION	SPECIFIC GRAVITY			PERCENT ABSORPTION		
.	NO. 50	NO. 100	NO. 200	PERCENT WEAR	PERCENT LOSS CA	PERCENT LOSS FA	BULK	BULK SSD	APPARENT		BULK	BULK SSD	APPARENT		CA	FA
				25.7	1.20										Innocuous	

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SPECIFIC GRAVITY AND ABSORPTION (ASTM C 127 AND C 128)							ALKALI REACTIVITY (ASTM C 289)		AGGREGATE USE
E AGGREGATE			FINE AGGREGATE						
GRAVITY		PERCENT ABSORPTION	SPECIFIC GRAVITY			PERCENT ABSORPTION			
LK SD	APPAR-ENT		BULK	BULK SSD	APPAR-ENT		CA	FA	
							Innocuous		Icr
									IIcr
									IIcr
									IIc/f
									IIf/c
									IIc/f
									IIc/f
									IIcr
									IIcr
									IIcr
									IIcr
									IIcr

FUGRO NATIONAL FIELD STATION
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WHITE RIVER VALLEY, NEVADA

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FUGRO NATIONAL, INC.

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MAP NUMBER	FIELD STATION	LOCATION	GEOLOGIC UNIT	MATERIAL DESCRIPTION	USCS SYMBOL	BOULDERS AND/OR COBBLES, PERCENT	DISTRIBUTION OF MATERIAL FINER THAN COBBLES, PERCENT			PLASTICITY
							GRAVEL	SAND	FINES	
51	NV-R-71	White Pine Range	Vu	Rhyolite						
52	NV-R-72	White River Valley	Au	Silty Sand	SM		20	65	15	Low
53	NV-R-73	White River Valley	Au	Sandy Gravel	GP		60	35	5	NP
54	NV-R-74	White River Valley	Aafs	Sandy Gravel	GP-GM		60	30	10	NP
55	NV-R-75	White River Valley	Aafs	Sandy Gravel	GP					NP
56	NV-R-76	White River Valley	Aaf	Sandy Silt	ML		20	35	45	Low
57	NV-R-77	Gap Mountains	Aaf	Gravelly Sand	SP		35	60	5	NP
58	NV-R-77	Gap Mountains	Ls	Limestone						
59	NV-R-78	White River Valley	Aaf	Silty Sand	SP-SM		25	65	10	NP
60	NV-R-79	White River Valley	Aaf	Silty Sand	SP		15	80	5	NP
61	NV-R-80	White River Valley	Aol	Sandy Gravel	GP					NP
62	NV-R-81	White River Valley	Au	Silty Sand	SP		35	55	10	NP
63	NV-R-82	White River Valley	Au	Silty Sand	SP-SM		35	50	15	NP

FIELD OBSERVATIONS														
PLASTICITY	HARDNESS	WEATHERING	DELETERIOUS MATERIALS	SIEVE ANALYSIS, PERCENT PASSING (ASTM C 136)										
				3"	1½"	¾"	⅜"	NO. 4	NO. 8	NO. 16	NO. 30	NO. 50	NO. 100	NO. 200
			Glassy											
Low			30% Glassy Volcanics, 1% Chert											
NP			20% Glassy, 25% Soft Particles											
NP			10% Glassy, Caliche Coatings											
NP			Caliche Coatings and Cementation		97.0	88.3	71.0	47.7	34.0	26.9	21.1			0
Low			Chert											
NP			35% Glassy Volcanics											
			Chert											
NP			75% Glassy, Extensive Caliche											
NP			75% Glassy Volcanics											
NP			1% Glassy and Chert Materials, Caliche		93.4	84.3	64.6	41.1	23.4	13.5	7.6			1.5
NP			35% Glassy Volcanics											
NP			40% Glassy Volcanics, Caliche											

LABORATORY TEST DATA

ABRASION TEST (ASTM C 131)	SOUNDNESS TEST (ASTM C 88)		SPECIFIC GRAVITY AND ABSORPTION (ASTM C 127 AND C 128)								ALKALI REACTIVITY (ASTM C 289)		AGGREGATE USE
			COARSE AGGREGATE				FINE AGGREGATE						
			SPECIFIC GRAVITY				SPECIFIC GRAVITY						
…RCENT WEAR	PERCENT LOSS CA	PERCENT LOSS FA	BULK	BULK SSD	APPARENT	PERCENT ABSORPTION	BULK	BULK SSD	APPARENT	PERCENT ABSORPTION	CA	FA	
													IIcr
													IIf
													IIc/f
													IIc/f
													IIc/f
													IIIf
													IIf/c
													IIcr
													IIf
													IIf
7	4.6												Ic IIf
													IIf/c
													IIf/c

FUGRO NATIONAL FIELD STATION
AND SUPPLEMENTARY TEST DATA
WHITE RIVER VALLEY, NEVADA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

TABLE A-1

FUGRO NATIONAL, INC.

MAP NUMBER	FIELD STATION	LOCATION	GEOLOGIC UNIT	MATERIAL DESCRIPTION	USCS SYMBOL	FIE				
						BOULDERS AND/OR COBBLES, PERCENT	DISTRIBUTION OF MATERIAL FINER THAN COBBLES, PERCENT			PLASTICITY
							GRAVEL	SAND	FINES	
64	NV-R-83	White River Valley	Vu	Basalt and Rhyolitic Tuff						
65	NV-R-84	White River Valley	Aaf	Silty Sand	SP-SM		[illegible]	65	15	None
66	NV-H-12	North Pahroc Range	Cau	Limestone						
67	NV-H-13	North Pahroc Range	Au	Gravelly Sand	SP		15	80	5	None
68	NV-H-14	Seaman Range	Cau	Limestone						
69	NV-H-108	White Pine Mountains	Su	Shale, Limestone, Dolomite						
70	WR-T-2	Forest Home	Aafs	Silty Gravel	GM					Low
71	WR-T-3	White River Valley	Au	Silty Sand	SM					None

IELD OBSERVATIONS				SIEVE ANALYSIS, PERCENT PASSING (ASTM C 136)											ABRASION
	HARDNESS	WEATHERING	DELETERIOUS MATERIALS	3"	1½"	¾"	⅜"	NO. 4	NO. 8	NO. 16	NO. 30	NO. 50	NO. 100	NO. 200	PER W
			Glassy, Soft												
ne			100% Glassy Volcanics												
			Abundant Chert												
ne			60% Vesicular Volcanics												
			Dolomitic												
			Soft Materials												
w				100	89	74	60	51	45*		34*		22	22	
n?							100	99	93*		67*		38	27	

LABORATORY TEST DATA

ABRASION TEST (ASTM C 131)	SOUNDNESS TEST (ASTM C 88)		SPECIFIC GRAVITY AND ABSORPTION (ASTM C 127 AND C 128)								ALKALI REACTIVITY (ASTM C 289)		AGGREGATE USE
			COARSE AGGREGATE				FINE AGGREGATE						
			SPECIFIC GRAVITY			PERCENT ABSORPTION	SPECIFIC GRAVITY			PERCENT ABSORPTION			
PERCENT WEAR	PERCENT LOSS		BULK	BULK SSD	APPARENT		BULK	BULK SSD	APPARENT		CA	FA	
	CA	FA											
													IIcr
													IIf
													IIcr
													IIf
													IIcr
													IIcr
													IIc/f
													IIf

FUGRO NATIONAL FIELD STATION AND SUPPLEMENTARY TEST DATA
WHITE RIVER VALLEY, NEVADA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE BMO

TABLE A-1

FUGRO NATIONAL, INC.

EXPLANATION OF EXISTING DATA

Existing data pertaining to aggregates were extracted from the State of Nevada Department of Highways. These reports are compilations of avaiable site data from existing files and records and are intended to accurately locate, investigate, and catalog materials needed for highway construction. Explanations for column headings which appear in Table A-2, that have not been previously discussed in Table A-1, are given below:

Column Heading	Explanation
Site Number	State of Nevada Department of Highways pit or site number. Locations correspond to map numbers listed on this table and placed on Drawing 1.
Soundness Test	The testing of aggregates to determine their resistance to disintegration by saturated solutions of sodium sulfate. It furnishes information helpful in judging the soundness of aggregates subject to weathering action, particularly when adequate information is not available from service records of the material exposed to actual weathering conditions.

MAP NUMBER	SITE NUMBER	DATA SOURCE	LOCATION	GEOLOGIC UNIT	MATERIAL DESCRIPTION	USCS SYMBOL	> 6"	3-6"	1½"
72	NY-33-1	Nevada Dept. of Highways	Sunnyside	Aafg	Clayey Gravel	GC	5	10	
73	NY-33-2	Nevada Dept. of Highways	S. Sunnyside	Aaf	Silty Gravel	GM	1	3	
74	NY-33-3	Nevada Dept. of Highways	S. Sunnyside	Aols	Silty Gravel	GM	[illegible]	0	
75	NY-33-5	Nevada Dept. of Highways	S. Sunnyside	Aafg	Limestone				
76	NY-33-6	Nevada Dept. of Highways	S. Sunnyside	Aaf	Limestone				
77	WP-08-1	Nevada Dept. of Highways	Highway 6	Aaf	Silty Gravel	GP-GM	[illegible]	17	
78	WP-08-3	Nevada Dept. of Highways	Highway 6	Aaf	Silty Gravel	GM	[illegible]	4.2	

SIEVE ANALYSIS												ABRASION TEST (ASTM C 131)	SOUNDNESS TEST (ASTM C 88)		SPECIFIC GRA (ASTM C			
															COARSE AGGREGATE			
															SPECIFIC GRAVITY			PERCENT
"	¾"	½"	¼"	⅜"	NO. 4	NO. 10	NO. 16	NO. 40	NO. 50	NO. 100	NO. 200	PERCENT WEAR	PERCENT LOSS CA	PERCENT LOSS FA	BULK	BULK SSD	APPARENT	
	32			54							5-24	24.9						
	17			30							3-28	32.5						
	3			7							4-35	39.6						
												26.9						
												27.9						
	32			44							6-15	28.4						
	19.7			28.4							4-49	29.4						

SOUNDNESS TEST (ASTM C 88)		SPECIFIC GRAVITY AND ABSORPTION (ASTM C 127 AND C 128)								PLASTICITY INDEX (ASTM D 423 AND D 424)	ALKALI REACTIVITY (ASTM C 289)	
[CENT] LOSS		COARSE AGGREGATE				FINE AGGREGATE						
		SPECIFIC GRAVITY			PERCENT ABSORPTION	SPECIFIC GRAVITY			PERCENT ABSORPTION			
[C]A	FA	BULK	BULK SSD	APPARENT		BULK	BULK SSD	APPARENT			CA	FA
										NP-14		
										NP		
										NP-4		
										NP-11		
										NP		

EXISTING TEST DATA
WHITE RIVER VALLEY, NEVADA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

TABLE A-2
PAGE 1 OF 1

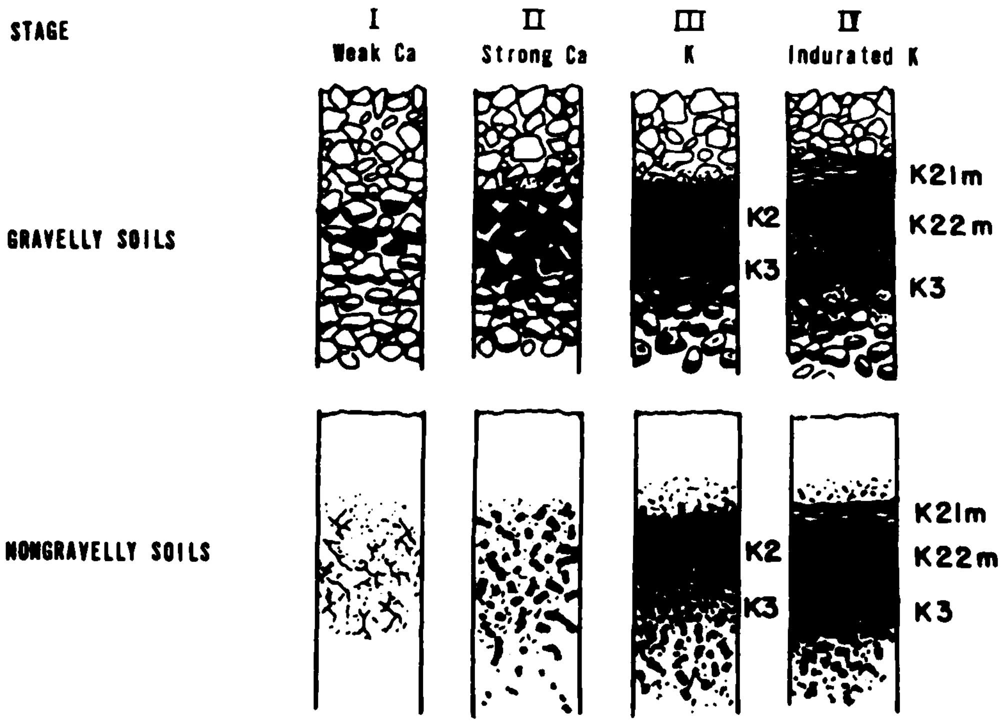
FUGRO NATIONAL, INC.

APPENDIX B

Summary of Caliche Development

DIAGNOSTIC CARBONATE MORPHOLOGY

STAGE	GRAVELLY SOILS	NONGRAVELLY SOILS
I	Thin, discontinuous pebble coatings	Few filaments or faint coatings
II	Continuous pebble coatings, some interpebble fillings	Few to abundant nodules, flakes, filaments
III	Many interpebble fillings	Many nodules and internodular fillings
IV	Laminar horizon overlying plugged horizon	Laminar horizon overlying plugged horizon



Stages of development of a caliche profile with time. Stage I represents incipient carbonate accumulation, followed by continuous build-up of carbonate until, in Stage IV, the soil is completely plugged.

SUMMARY OF CALICHE DEVELOPMENT

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

FIGURE
B-1

FUGRO NATIONAL, INC.

Reference: Gile, L.H. Peterson, F.F., and Grossman, R.B., 1965. The K horizon: A master horizon of carbonate accumulation: Soil Science, v. 99, p. 74-82.

APPENDIX C

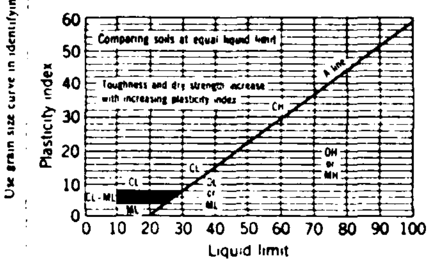
Unified Soil Classification System

Major divisions		Field Identification Procedures (Excluding particles larger than 3 in. and basing fractions on estimated weights)	Group Symbols [a]	Typical Names	Information Required for Describing Soils	Laboratory Classification Criteria
Coarse-grained soils: More than half of material is *larger* than No. 200 sieve size[b] (The No. 200 sieve size is about the smallest particle visible to naked eye). Gravels: More than half of coarse fraction is larger than No. 4 sieve size (For visual classification, the ¼ in. size may be used as equivalent to the No. 4 sieve size)	Clean gravels (little or no fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes	*GW*	Well graded gravels, gravel-sand mixtures, little or no fines	Give typical name; indicate approximate percentages of sand and gravel, maximum size, angularity, surface condition, and hardness of the coarse grains; local or geologic name and other pertinent descriptive information; and symbols in parentheses	$C_U = \frac{D_{60}}{D_{10}}$ Greater than 4; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3
	Clean gravels (little or no fines)	Predominantly one size or a range of sizes with some intermediate sizes missing	*GP*	Poorly graded gravels, gravel-sand mixtures, little or no fines		Not meeting all gradation requirements for *GW*
	Gravels with fines (appreciable amount of fines)	Nonplastic fines (for identification procedures see *ML* below)	*GM*	Silty gravels, poorly graded gravel-sand-silt mixtures	For undisturbed soils add information on stratification, degree of compactness, cementation, moisture conditions and drainage characteristics	Atterberg limits below "A" line, or *PI* less than 4 — Above "A" line with *PI* between 4 and 7 are *borderline* cases requiring use of dual symbols
	Gravels with fines (appreciable amount of fines)	Plastic fines (for identification procedures, see *CL* below)	*GC*	Clayey gravels, poorly graded gravel-sand-clay mixtures		Atterberg limits above "A" line, with *PI* greater than 7
Sands: More than half of coarse fraction is smaller than No. 4 sieve size	Clean sands (little or no fines)	Wide range in grain sizes and substantial amounts of all intermediate particle sizes	*SW*	Well graded sands, gravelly sands, little or no fines	Example: *Silty sand*, gravelly, about 20% hard, angular gravel particles ½-in. maximum size, rounded and subangular sand grains coarse to fine, about 15% non-plastic fines with low dry strength, well compacted and moist in place, alluvial sand, (*SM*)	$C_U = \frac{D_{60}}{D_{10}}$ Greater than 6; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3
	Clean sands (little or no fines)	Predominantly one size or a range of sizes with some intermediate sizes missing	*SP*	Poorly graded sands, gravelly sands, little or no fines		Not meeting all gradation requirements for *SW*
	Sands with fines (appreciable amount of fines)	Nonplastic fines (for identification procedures, see *ML* below)	*SM*	Silty sands, poorly graded sand-silt mixtures		Atterberg limits below "A" line or *PI* less than 5 — Above "A" line with *PI* between 4 and 7 are *borderline* cases requiring use of dual symbols
	Sands with fines (appreciable amount of fines)	Plastic fines (for identification procedures, see *CL* below)	*SC*	Clayey sands, poorly graded sand-clay mixtures		Atterberg limits below "A" line with *PI* greater than 7

Laboratory classification criteria for coarse-grained soils: Use grain size curve in identifying the fractions as given under field identification. Determine percentages of gravel and sand from grain size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size) coarse grained soils are classified as follows: Less than 5% *GW, GP, SW, SP*; More than 12% *GM, GC, SM, SC*; 5% to 12% *Borderline* cases requiring use of dual symbols.

Identification Procedures on Fraction Smaller than No. 40 Sieve Size

Major divisions		Dry Strength (crushing characteristics)	Dilatancy (reaction to shaking)	Toughness (consistency near plastic limit)	Group Symbols	Typical Names	Information Required for Describing Soils
Fine-grained soils: More than half of material is *smaller* than No. 200 sieve size	Silts and clays liquid limit less than 50	None to slight	Quick to slow	None	*ML*	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity	Give typical name; indicate degree and character of plasticity, amount and maximum size of coarse grains; colour in wet condition, odour if any, local or geologic name, and other pertinent descriptive information, and symbol in parentheses
	Silts and clays liquid limit less than 50	Medium to high	None to very slow	Medium	*CL*	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	For undisturbed soils add information on structure, stratification, consistency in undisturbed and remoulded states, moisture and drainage conditions
	Silts and clays liquid limit less than 50	Slight to medium	Slow	Slight	*OL*	Organic silts and organic silt-clays of low plasticity	Example: *Clayey silt*, brown, slightly plastic, small percentage of fine sand, numerous vertical root holes, firm and dry in place, loess, (*ML*)
	Silts and clays liquid limit greater than 50	Slight to medium	Slow to none	Slight to medium	*MH*	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	
	Silts and clays liquid limit greater than 50	High to very high	None	High	*CH*	Inorganic clays of high plasticity, fat clays	
	Silts and clays liquid limit greater than 50	Medium to high	None to very slow	Slight to medium	*OH*	Organic clays of medium to high plasticity	
Highly Organic Soils		Readily identified by colour, odour, spongy feel and frequently by fibrous texture			*Pt*	Peat and other highly organic soils	



Plasticity chart
for laboratory classification of fine grained soils

From Wagner, 1957.
[a] *Boundary classifications*: Soils possessing characteristics of two groups are designated by combinations of group symbols. For example *GW-GC*, well graded gravel-sand mixture with clay binder.
[b] All sieve sizes on this chart are U.S. standard.

Field Identification Procedure for Fine Grained Soils or Fractions

These procedures are to be performed on the minus No. 40 sieve size particles, approximately 1/64 in. For field classification purposes, screening is not intended, simply remove by hand the coarse particles that interfere with the tests.

Dilatancy (Reaction to shaking)
After removing particles larger than No. 40 sieve size, prepare a pat of moist soil with a volume of about one-half cubic inch. Add enough water if necessary to make the soil soft but not sticky.
Place the pat in the open palm of one hand and shake horizontally, striking vigorously against the other hand several times. A positive reaction consists of the appearance of water on the surface of the pat which changes to a livery consistency and becomes glossy. When the sample is squeezed between the fingers, the water and gloss disappear from the surface, the pat stiffens and finally it cracks or crumbles. The rapidity of appearance of water during shaking and of its disappearance during squeezing assist in identifying the character of the fines in a soil.
Very fine clean sands give the quickest and most distinct reaction whereas a plastic clay has no reaction. Inorganic silts, such as a typical rock flour, show a moderately quick reaction.

Dry Strength (Crushing characteristics)
After removing particles larger than No. 40 sieve size, mould a pat of soil to the consistency of putty, adding water if necessary. Allow the pat to dry completely by oven, sun or air drying, and then test its strength by breaking and crumbling between the fingers. This strength is a measure of the character and quantity of the colloidal fraction contained in the soil. The dry strength increases with increasing plasticity.
High dry strength is characteristic for clays of the CH group. A typical inorganic silt possesses only very slight dry strength. Silty fine sands and silts have about the same slight dry strength, but can be distinguished by the feel when powdering the dried specimen. Fine sand feels gritty whereas a typical silt has the smooth feel of flour.

Toughness (Consistency near plastic limit)
After removing particles larger than the No. 40 sieve size, a specimen of soil about one-half inch cube in size, is moulded to the consistency of putty. If too dry, water must be added and if sticky, the specimen should be spread out in a thin layer and allowed to lose some moisture by evaporation. Then the specimen is rolled out by hand on a smooth surface or between the palms into a thread about one-eight inch in diameter. The thread is then folded and re-rolled repeatedly. During this manipulation the moisture content is gradually reduced and the specimen stiffens, finally loses its plasticity, and crumbles when the plastic limit is reached.
After the thread crumbles, the pieces should be lumped together and a slight kneading action continued until the lump crumbles.
The tougher the thread near the plastic limit and the stiffer the lump when it finally crumbles, the more potent is the colloidal clay fraction in the soil. Weakness of the thread at the plastic limit and quick loss of coherence of the lump below the plastic limit indicate either inorganic clay of low plasticity, or materials such as kaolin-type clays and organic clays which occur below the A-line.
Highly organic clays have a very weak and spongy feel at the plastic limit.

UNIFIED SOIL CLASSIFICATION SYSTEM

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

TABLE C-1

FUGRO NATIONAL, INC.

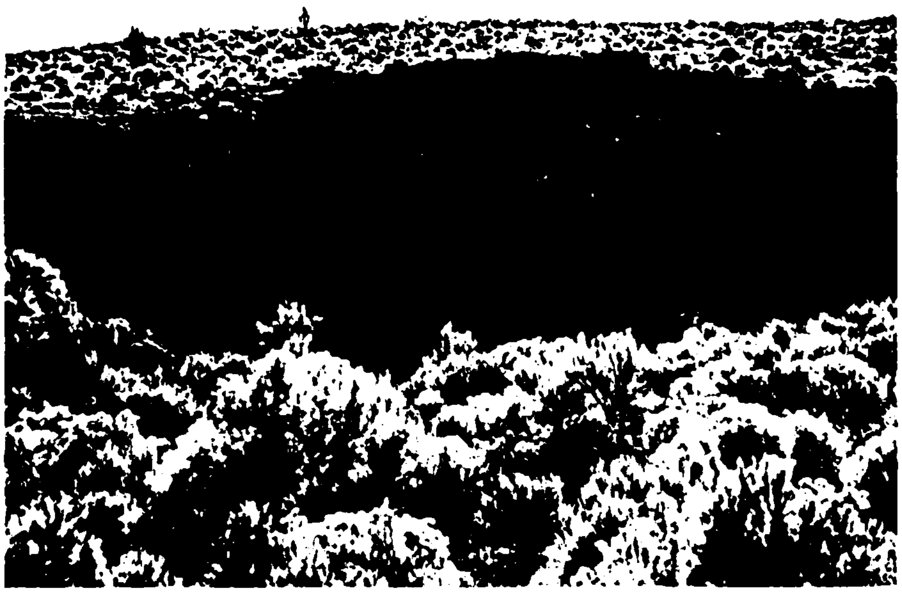
FN-TR-37-c

APPENDIX D

White River Valley Study Area Photographs

Slightly metamorphosed sandstone member of the Guilmette Formation (Cau) located north of Fox Mountain in the south central portion of the study area; Class I, crushed rock aggregate source (Field Station 6).

WHITE RIVER VALLEY STUDY AREA PHOTOGRAPH	
MX SITING INVESTIGATION DEPARTMENT OF THE AIR FORCE - BMO	FIGURE D-1
FUGRO NATIONAL, INC.	



Limestone member of the Guilmette Formation (Cau) located in the Horse Range in the north central portion of the study area; Class I, crushed rock aggregate source (Field Station 12).

WHITE RIVER VALLEY STUDY AREA PHOTOGRAPH
MX SITING INVESTIGATION DEPARTMENT OF THE AIR FORCE - BMO
FIGURE D-2
FUGRO NATIONAL, INC.

APPENDIX E

Fugro National Geologic Unit Cross Reference

UARSA POTENTIAL AGGREGATE SOURCE SYMBOLS / FUGRO NATIONAL GENERAL GEOLOGIC UNIT EXPLANATION

ROCK

Shown in regions where rock is exposed, the areally predominant (greater than 70 percent) rock type is indicated. In those areas where two rock types occur the predominant rock type is shown followed by the subordinate rock type (e.g. $S_{2_{ur}}/I_{4_{r}}$). Rock may be subdivided into bedrock (B).

UARSA Potential Aggregate Source Symbols	Unit	Fugro National General Geologic Unit Explanation
	I	IGNEOUS (UNDIFFERENTIATED) Rocks formed by solidification of a molten or partially molten mass
Gr	I_1	Intrusive Plutonic rocks formed by solidification of molten material beneath the surface (e.g. granite, granodiorite, diorite, gabbro)
Vu	I_2	Extrusive (intermediate and acidic) Volcanic rocks of intermediate and acidic composition formed by solidification of molten material at or near the surface (e.g. rhyolite, latite, dacite, andesite)
Vb	I_3	Extrusive (basic) Volcanic rocks of basic composition generally formed by solidification of molten materials at or near the surface (e.g. basalt)
Vu	I_4	Extrusive (pyroclastic) Rocks formed by accumulation of volcanic ejecta (e.g. ash, tuff, welded tuff, agglomerate)
Su	S	SEDIMENTARY (UNDIFFERENTIATED) Rocks formed by accumulation of clastic solids, organic solids and or chemically precipitated minerals
Su, QTz	S_1	Arenaceous and or Siliceous Rocks Composed of sand size particles (e.g. sandstone, orthoquartzite) or of cryptocrystalline silica (e.g. opal, chert)
Ls, Do, Cau	S_2	Carbonate Rocks Composed predominantly of calcium carbonate detritus or chemical precipitates (e.g. limestone, dolomite, chalk)
	S_3	Argillaceous Rocks Composed of clay and silt-sized particles (e.g. siltstone, shale, claystone)
	S_4	Evaporite Rocks Precipitated from solution as a result of evaporation (e.g. halite, gypsum, anhydrite, sylvite)
Su	S_5	Coarse Clastic Rocks Composed of gravel-sized or larger clasts (e.g. conglomerate, breccia)
Mu	M	METAMORPHIC (UNDIFFERENTIATED) Rocks formed through recrystallization in the solid state of preexisting rocks by heat and pressure
Mu	M_1	Coarse grained rocks formed by higher-grade regional metamorphism either banded or granular (e.g. gneiss, granulite, amphibolite)
Mu	M_2	Fine grained schistose rocks formed by lower grade regional metamorphism (e.g. schist, slate, phyllite)
Mu	M_3	Nonfoliated rocks formed chiefly by contact metamorphism (e.g. hornfels, marble)
QTz	M_4	Metaquartzite rocks formed by metamorphism of highly siliceous rocks

BASIN-FILL

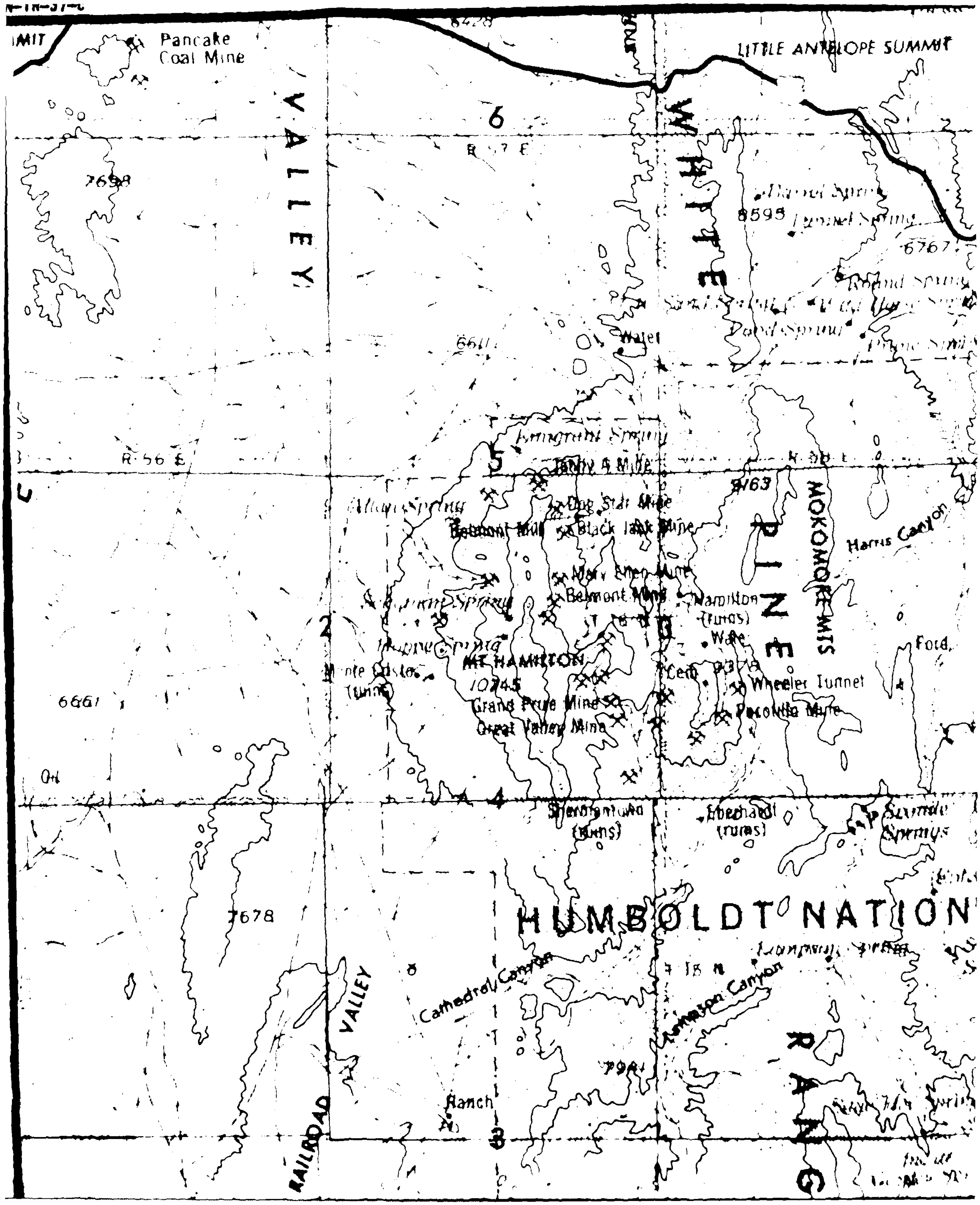
UARSA Potential Aggregate Source Symbols	Unit	Fugro National General Geologic Unit Explanation
	A	BASIN-FILL DEPOSITS Fine- to coarse-grained materials deposited principally by wind, water or gravity
Aal	A_1	Younger Fluvial Deposits Major modern stream channel and flood-plain deposits
Au, Aal	A_2	Older Fluvial Deposits Older incised stream channel and flood-plain deposits in elevated terraces bordering major modern drainages
Au	A_3	Eolian Deposits Wind-blown deposits of sand occurring as either thin sheets (A_{3s}) or dunes (A_{3d})
Aol	A_4	Playa and Lacustrine Deposits Deposits occurring in modern active playas (A_4) or in either inactive playas or older lake beds and abandoned shorelines associated with extinct lakes (A_{4o})
Aaf	A_5	Alluvial Fan Deposits Alluvial deposits consisting of debris flow and water laid alluvium near mountain fronts grading into predominantly water laid alluvium deposited in shifting distributary channels near the basin center. Younger (A_{5y}), intermediate (A_{5i}) and older (A_{5o}) alluvial fans are differentiated by surface soil development, terrain conditions and present depositional/erosional environment.
Au	A_1/A_5	Mixed non-rock units. Most areally extensive unit is listed first
Aaf	$A_{5y}(A_{5i})$	Parenthetic unit underlies thin veneer of overlying mapped unit

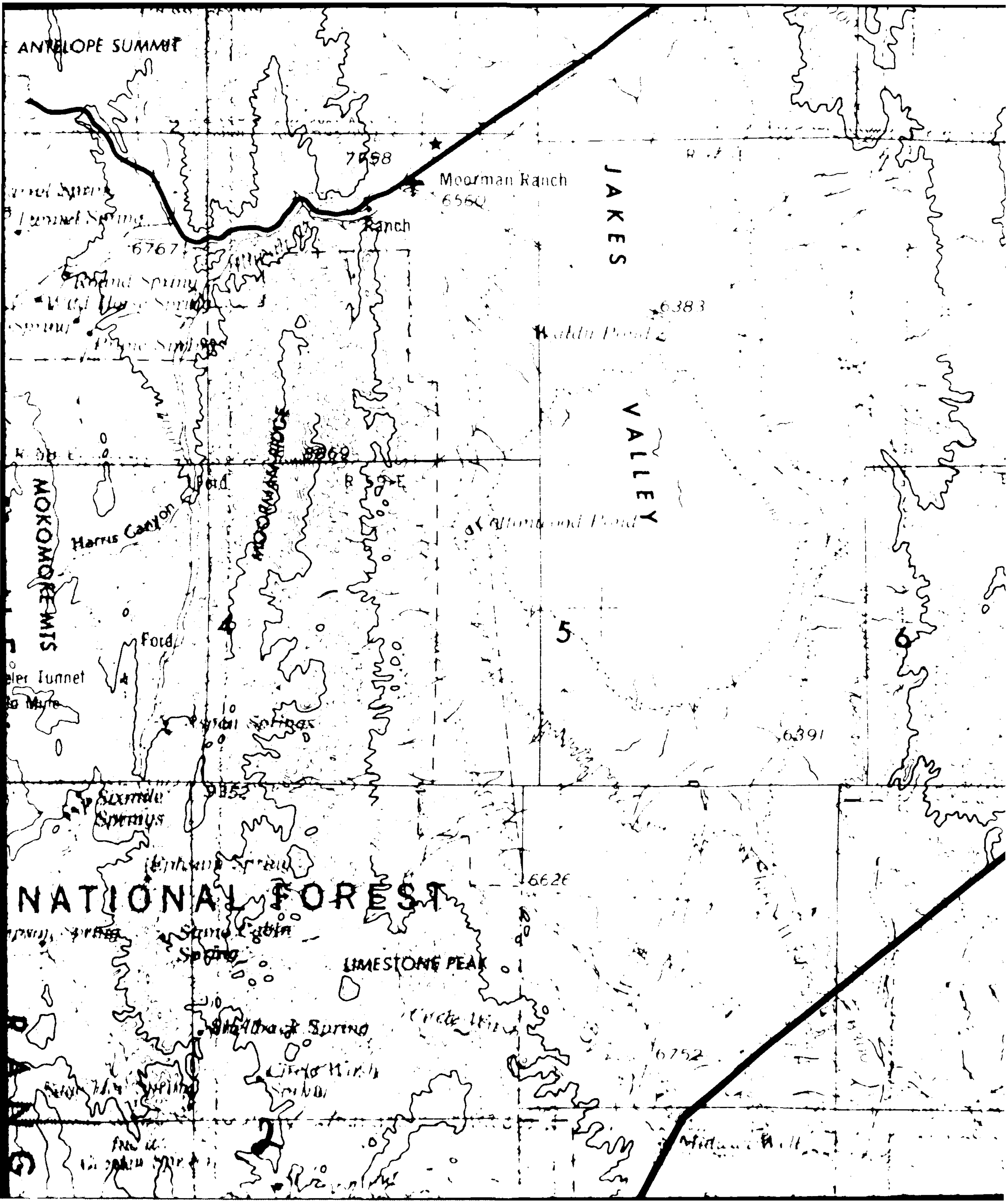
FUGRO NATIONAL GEOLOGIC UNIT CROSS REFERENCE

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE BMO

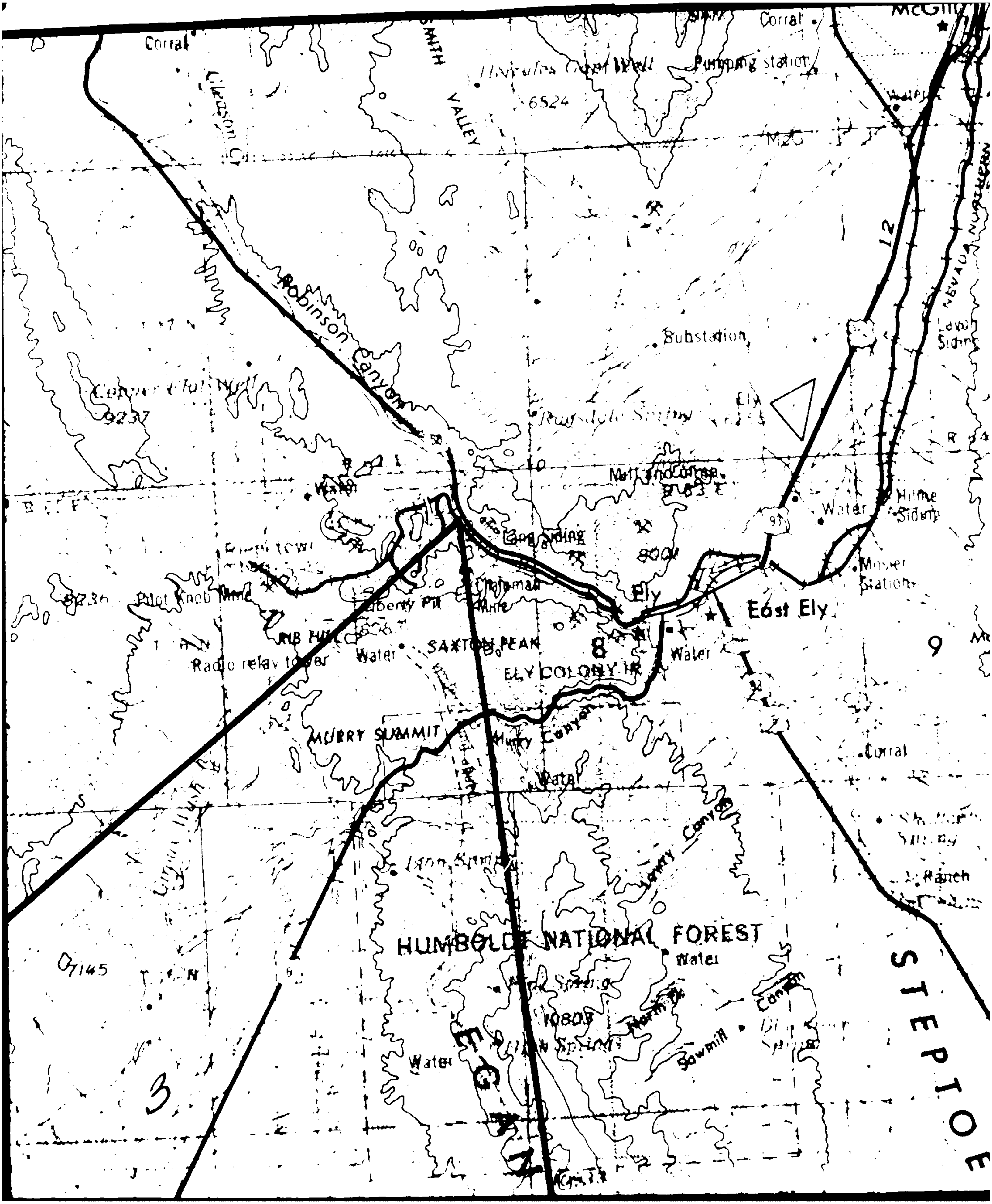
FIGURE E-1

FUGRO NATIONAL, INC.

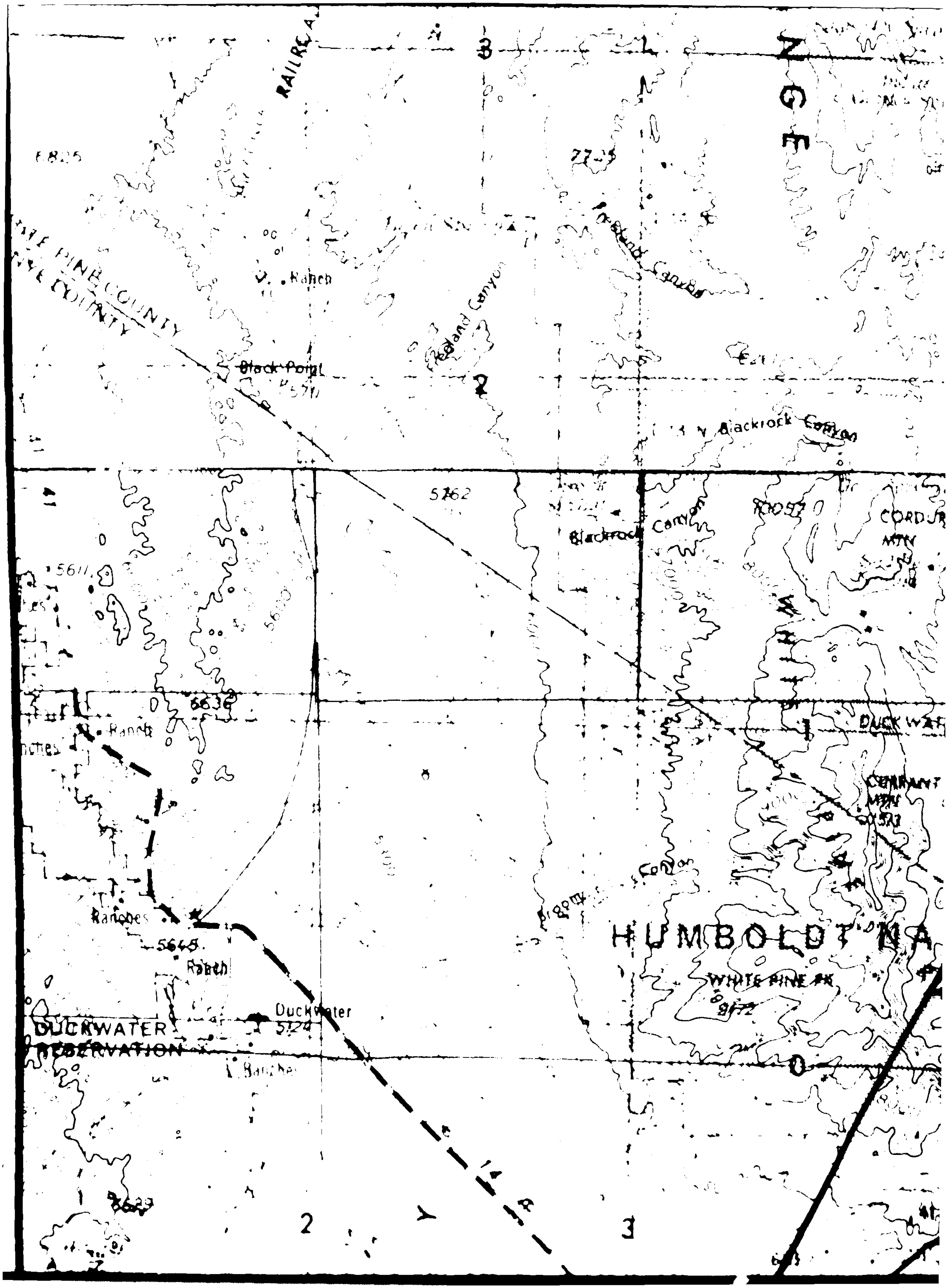

Pancake
Coal Mine
LITTLE ANTELOPE SUMMIT
VALLEY
WHITE
PINE
MOKOMOKE MTS
6
5
4
3
2
R 56 E
7698
8595
6767
6661
9163
Emigrant Spring
Belmont Mill
Black Jack Mine
Mary Ellen Mine
Belmont Mine
Hamilton
(ruins)
Harris Canyon
MT HAMILTON
10745
Grand Prize Mine
Great Valley Mine
Wheeler Tunnel
Pocotillo Mine
Ford
Shermantown
(ruins)
Eberhardt
(ruins)
HUMBOLDT NATION
7678
Cathedral Canyon
VALLEY
RAILROAD
Ranch
RANG



ANTELOPE SUMMIT
7558
Moorman Ranch
6560
Ranch
JAKES
6767
6383
VALLEY
MOKOMOKE MTS
MOORMAN RIDGE
Harris Canyon
Ford
8869
5
6
Ford
6391
Sixmile Springs
9852
6626
NATIONAL FOREST
LIMESTONE PEAK
6752

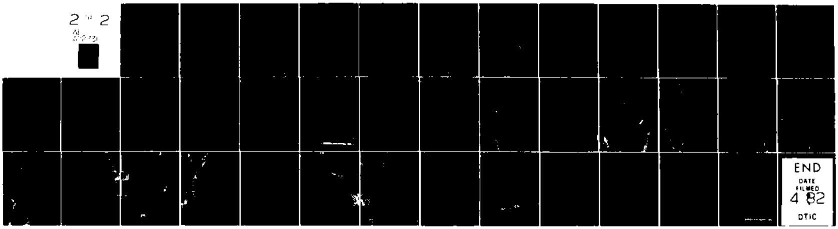


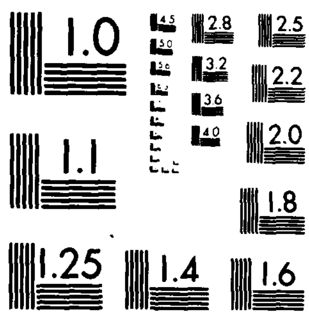
Corral
SMITH
VALLEY
6524
Pumping station
Corral
McGill
12
NEVADA NORTHERN
Robinson Canyon
Substation
Ely
9237
50
Water
Lane Siding
8001
Hiline Siding
Water
93
Mosier Station
9236
Pilot Knob Mine
Liberty Pit
Chainman Mine
Ely
East Ely
SAXTON PEAK
Water
Radio relay tower
8
ELY COLONY IR
Water
9
MURRY SUMMIT
Murry Canyon
Corral
Ranch
Lowry Canyon
HUMBOLDT NATIONAL FOREST
Water
7145
6
10808
North Fk
Sawmill
Canyon
Water
EGAN
STEPTOE
3


RAILROAD
WHITE PINE COUNTY
NYE COUNTY
Ranch
Black Point
Blackrock Canyon
5762
CORDUROY MTN
6636
Ranch
Ranches
DUCKWATER
CURRANT MTN
Ranches
5645
Ranch
Duckwater
5124
DUCKWATER RESERVATION
HUMBOLDT NA
WHITE PINE PK
Ranches
2
3

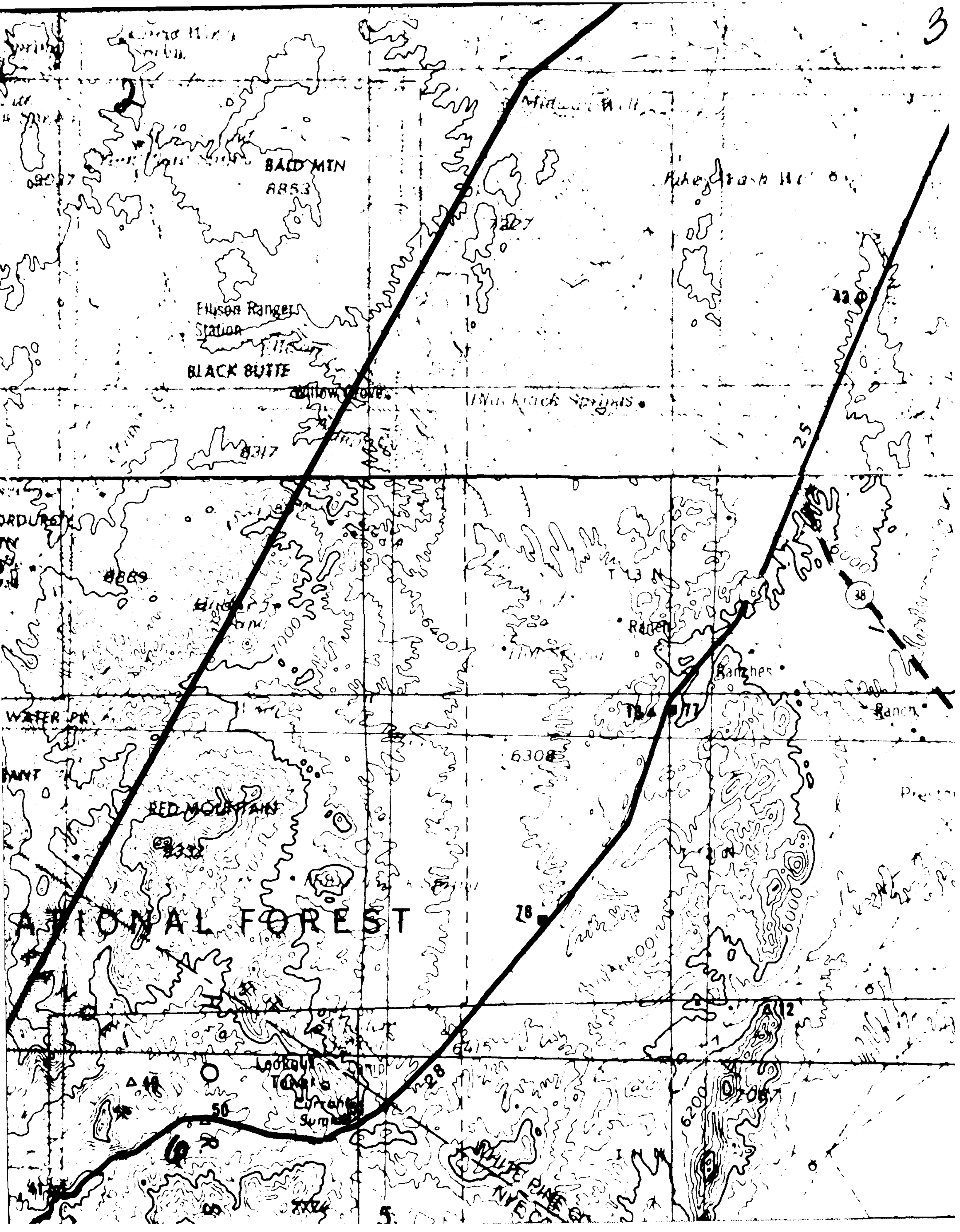
AD-A112 731 FUGRO NATIONAL INC LONG BEACH CA F/G 8/7
MX SITING INVESTIGATION. GEOTECHNICAL EVALUATION. AGGREGATE RES--ETC(U)
JUN 80 F04704-80-C-0006
UNCLASSIFIED FN-TR-37-C NL

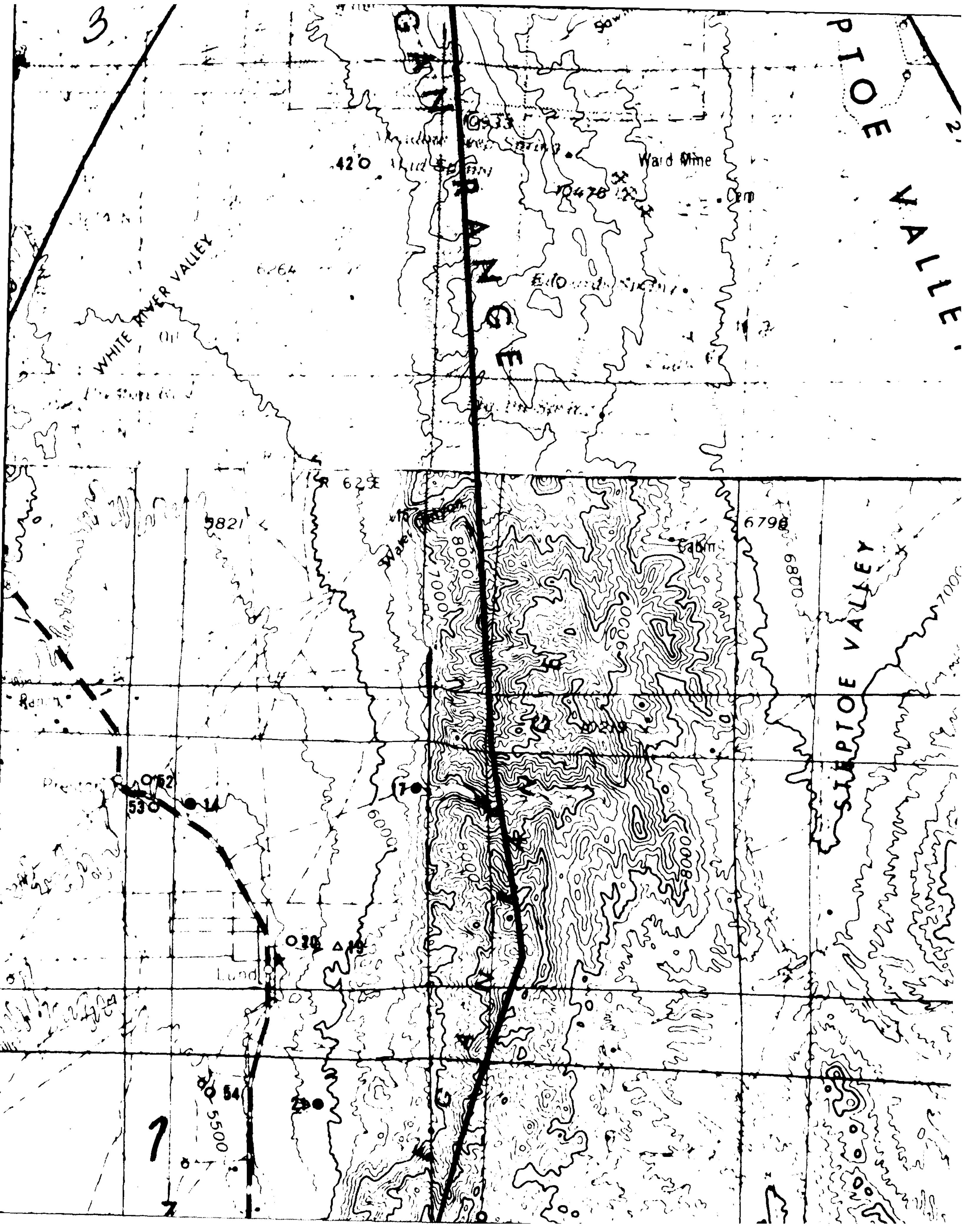
2 of 2



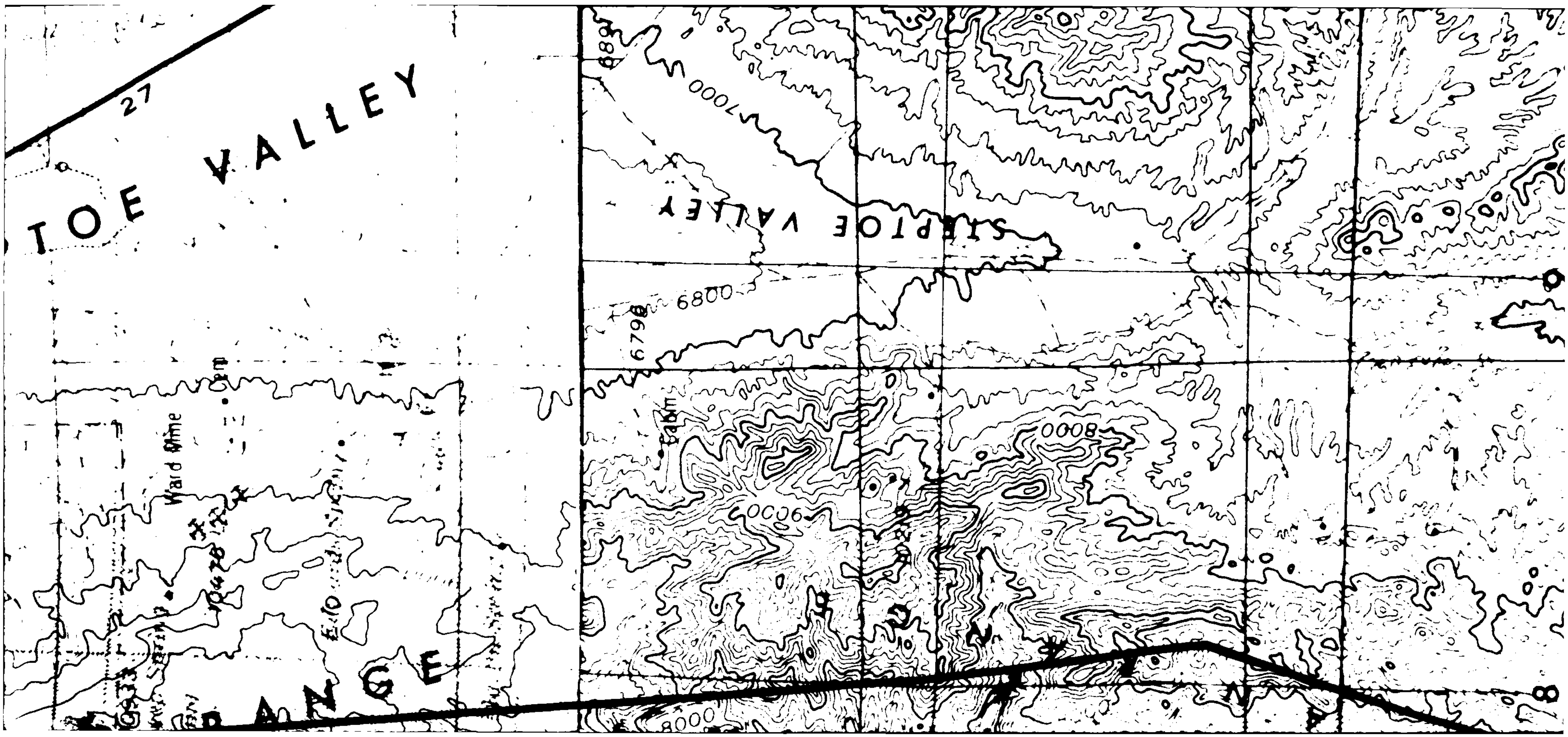


MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

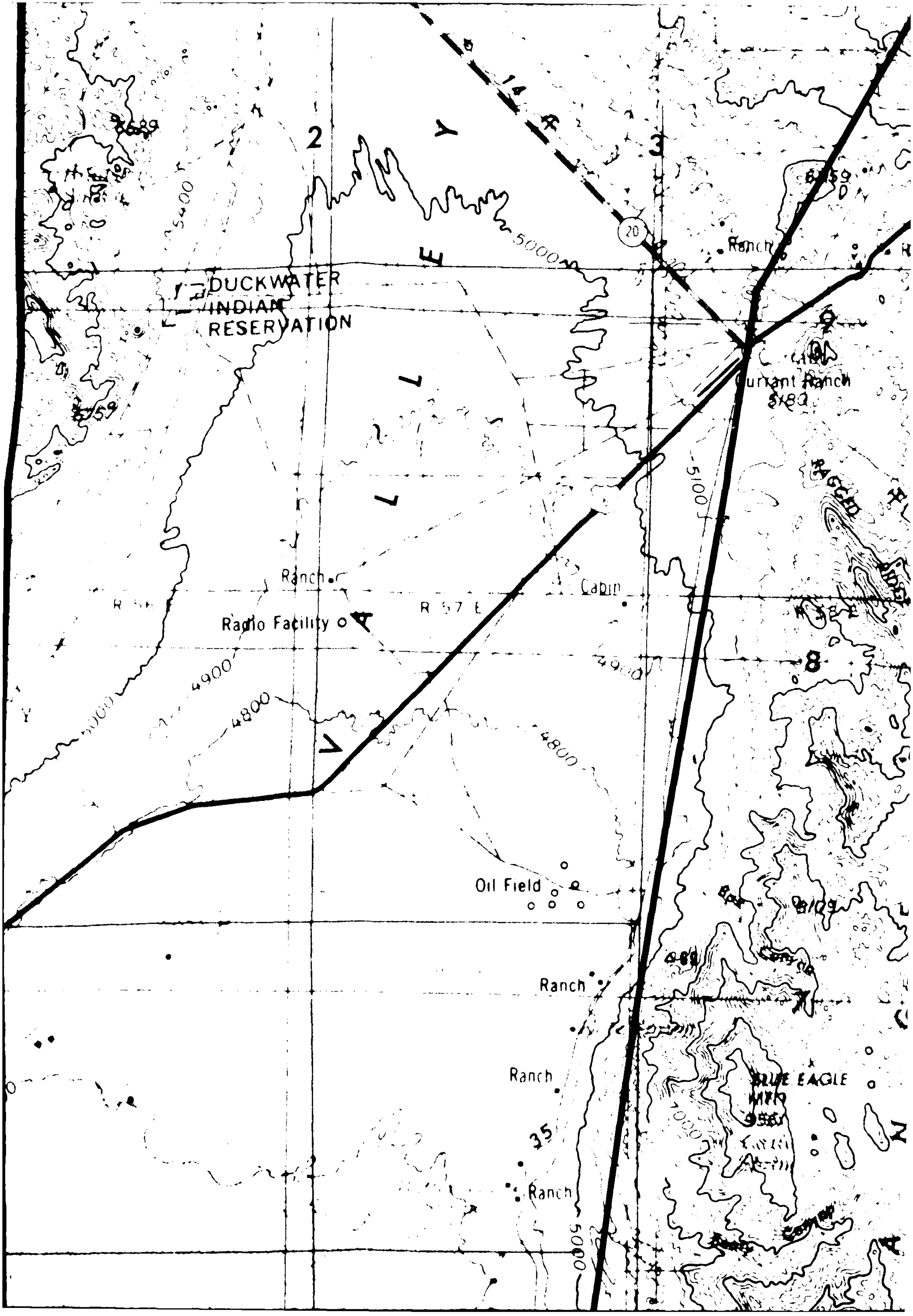

BALD MTN
8853
Ellison Ranger Station
BLACK BUTTE
Willow Creek
8317
8889
T 13 N
Ranch
Ranches
Ranch
WATER PK
6308
RED MOUNTAIN
8332
NATIONAL FOREST
28
6415
Lookout Tower
Currant Summit
50
WHITE PINE CO
NYE CO
25
38
6000
6200



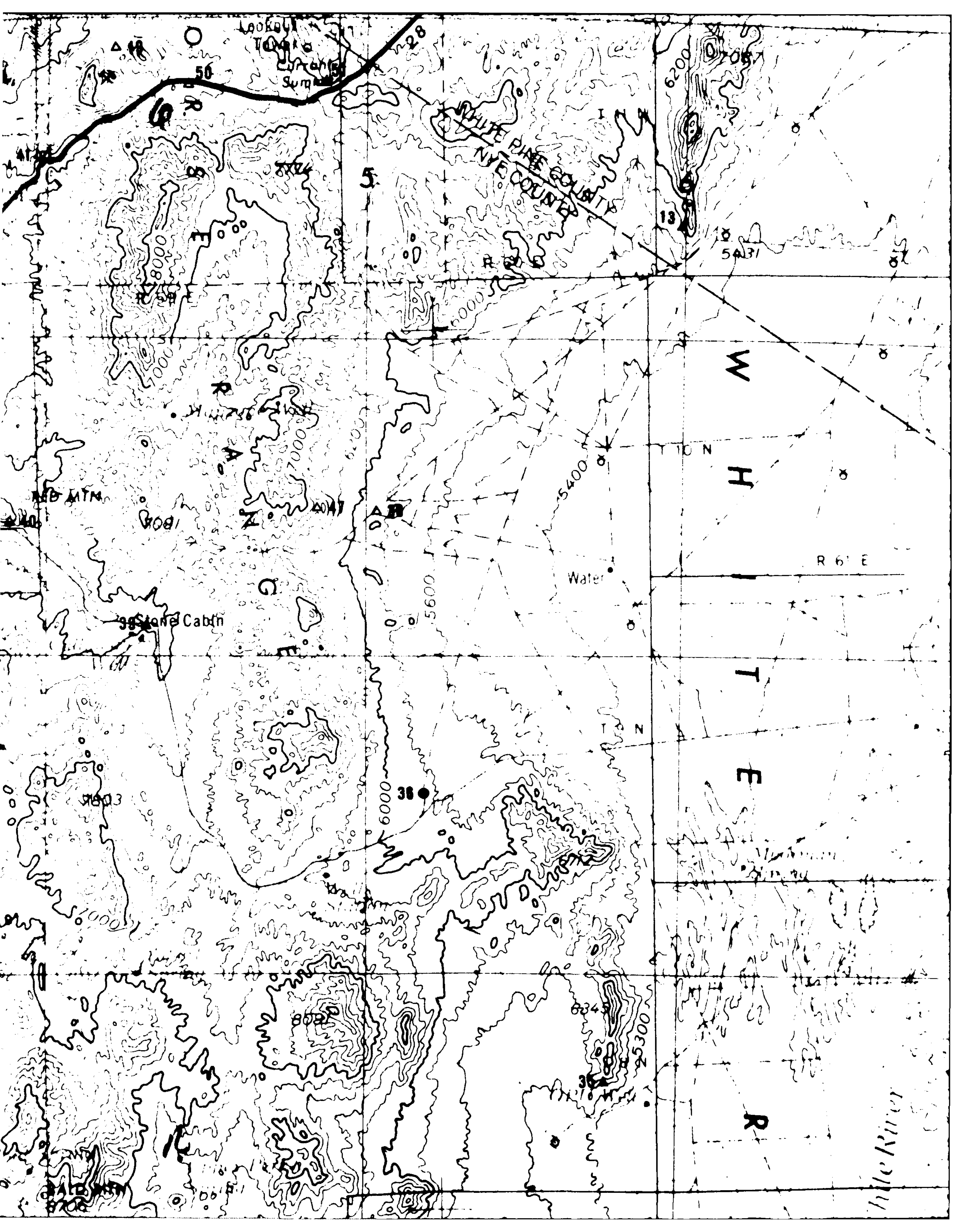
3
2
1
PTOE VALLE
WHITE RIVER VALLEY
RANGE
Ward Mine
Cem
6264
5821
6798
STEPTOE VALLEY
Cabin
7000
8000
9000
6000
6800
5500
Lund
52
53
14
54



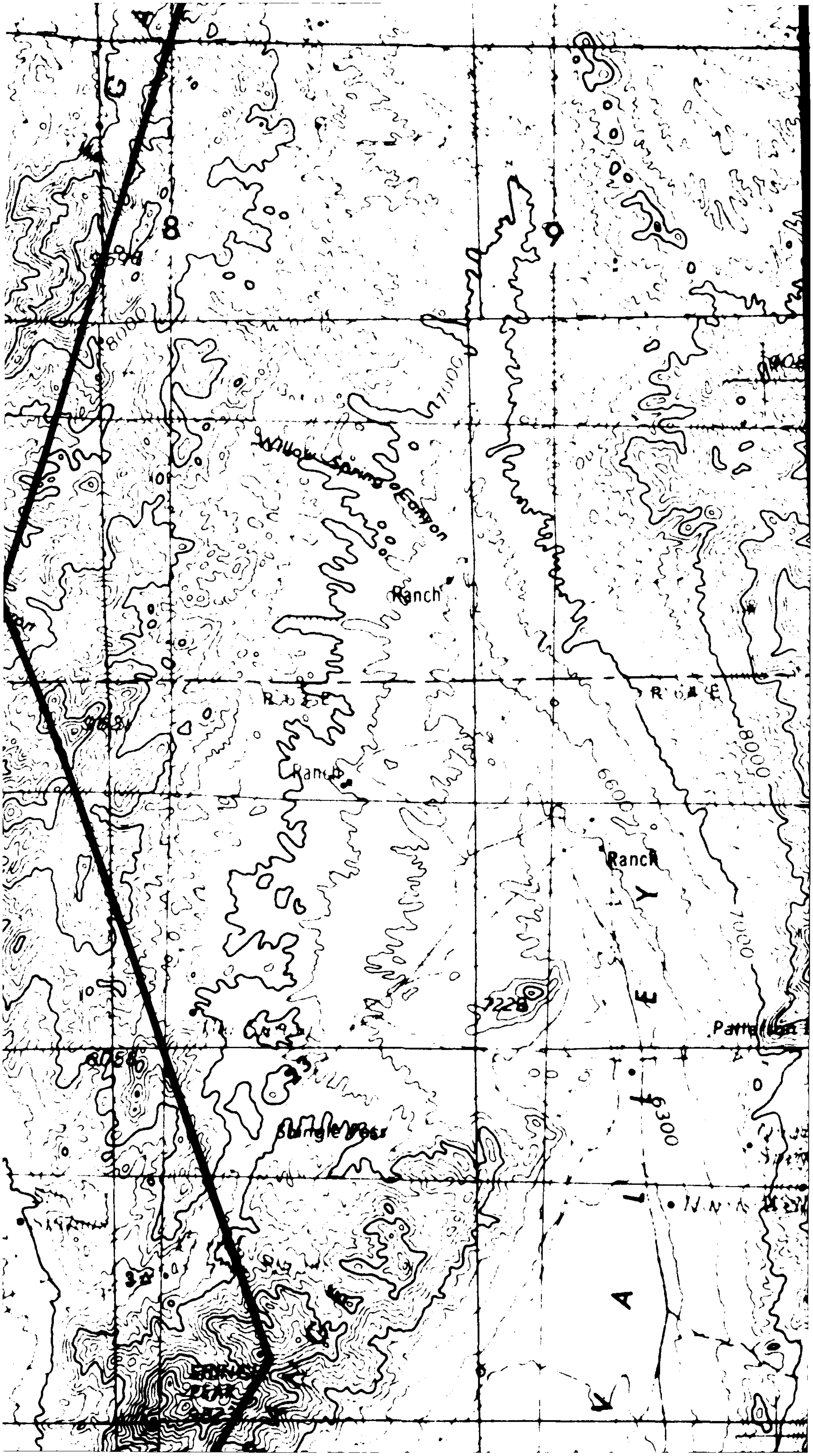
TOE VALLEY
27
Ward Mine
Cem
10478
STEPTOE VALLEY
7000
6800
6798
Cabin
9000
8000
10219
RANGE
8

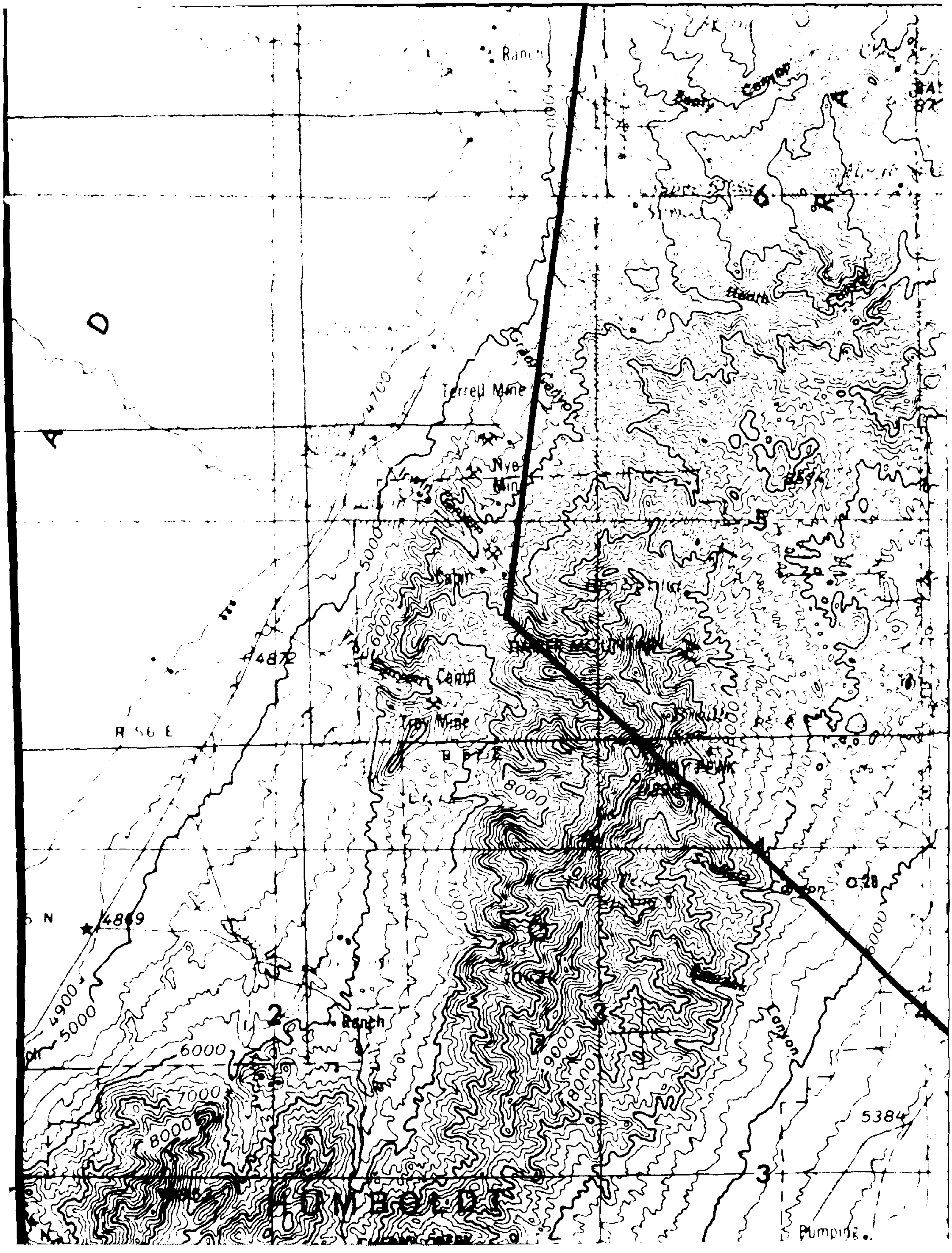


DUCKWATER
INDIAN
RESERVATION
V A L L E Y
Radio Facility
Ranch
Cabin
Currant Ranch
5180
R 57 E
Oil Field
Ranch
Ranch
Ranch
BLUE EAGLE
MTN
20
14
2
3
8
35
5000
4900
4800
5100
5400

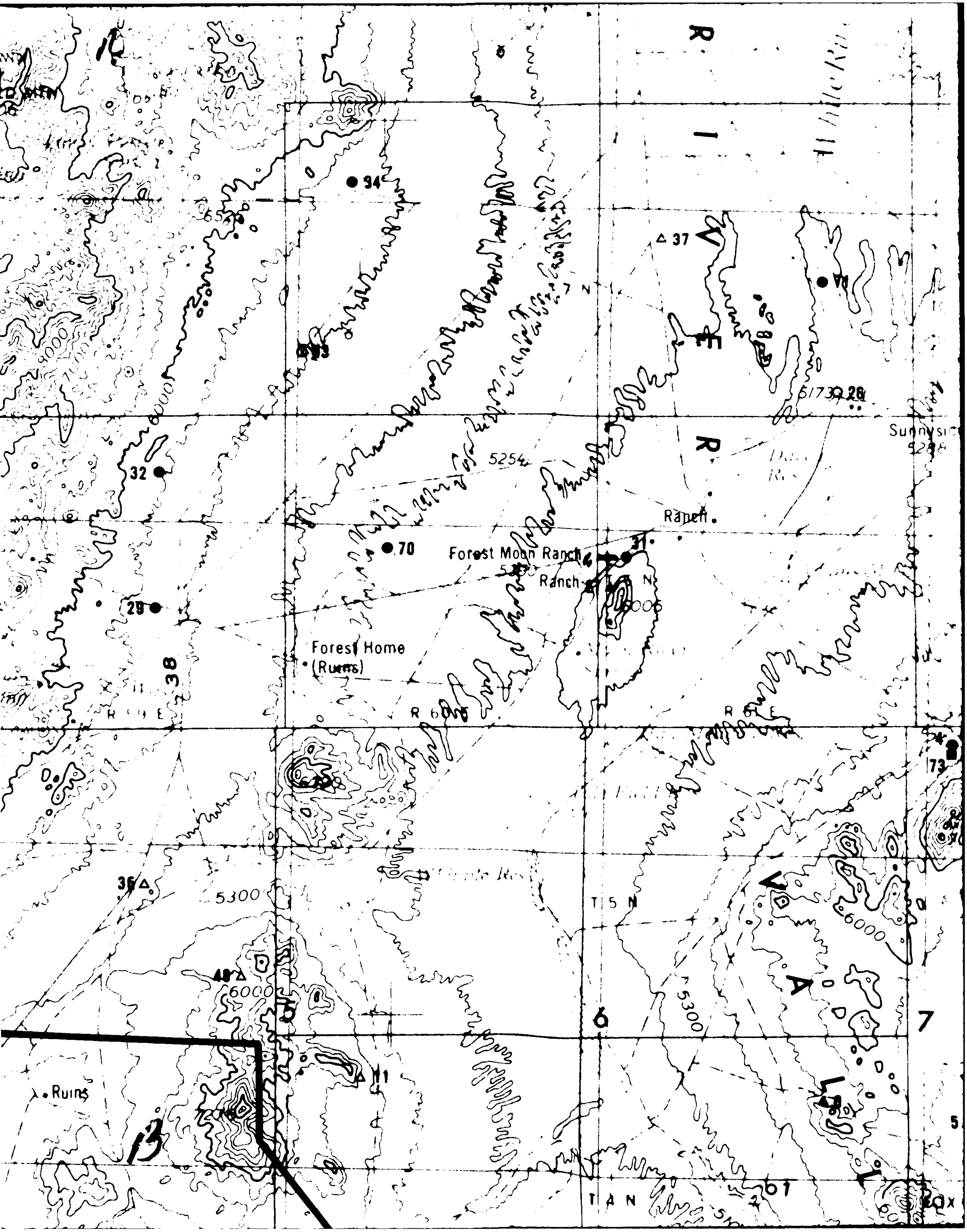


Lookout Tower
Currant Summit
50
28
WHITE PINE COUNTY
NYE COUNTY
13
5431
8000
7000
6000
5400
5600
5300
R 61 E
Water
Stone Cabin
7803
8081
6345
36
W H I T E
R
White River

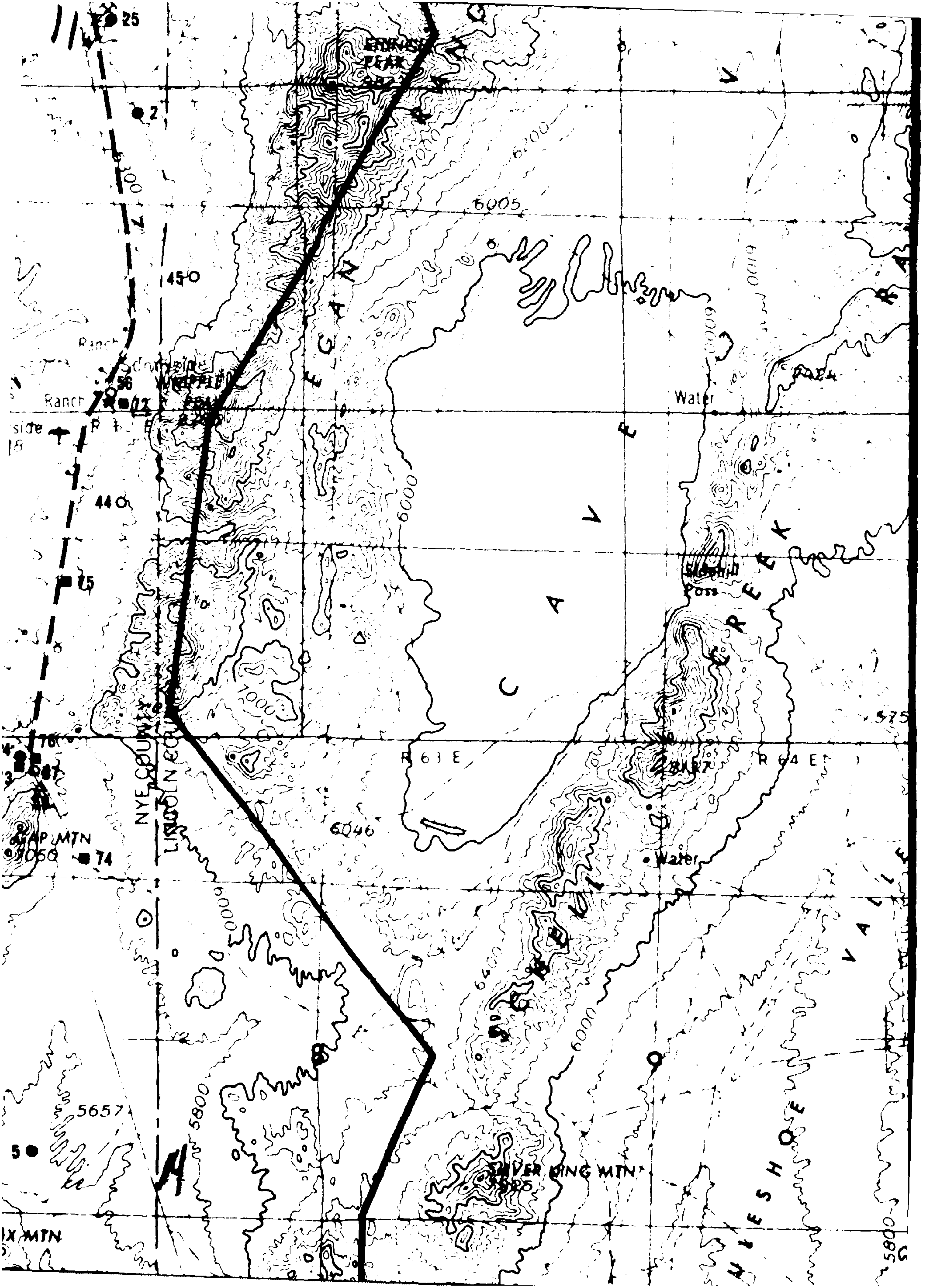

8
9
Willow Spring Canyon
Ranch
Ranch
Ranch
7000
8000
7228
Shingle Pass
6300



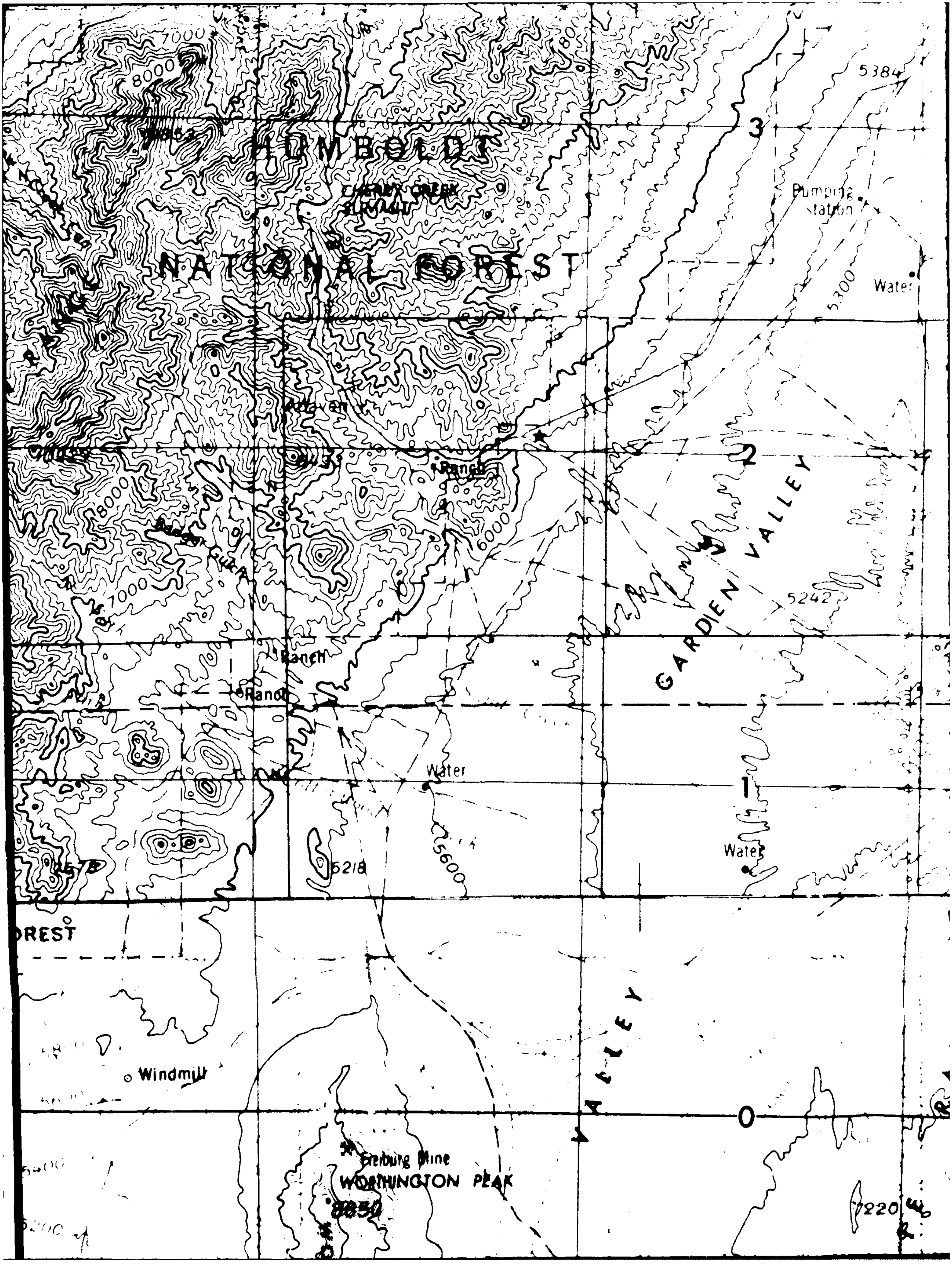
Ranch
Terrell Mine
Nye
Camp
Troy Mine
R 56 E
4872
4869
4700
4900
5000
6000
7000
8000
9000
2
Ranch
HUMBOLDT
Canyon
5384
3
Pumping



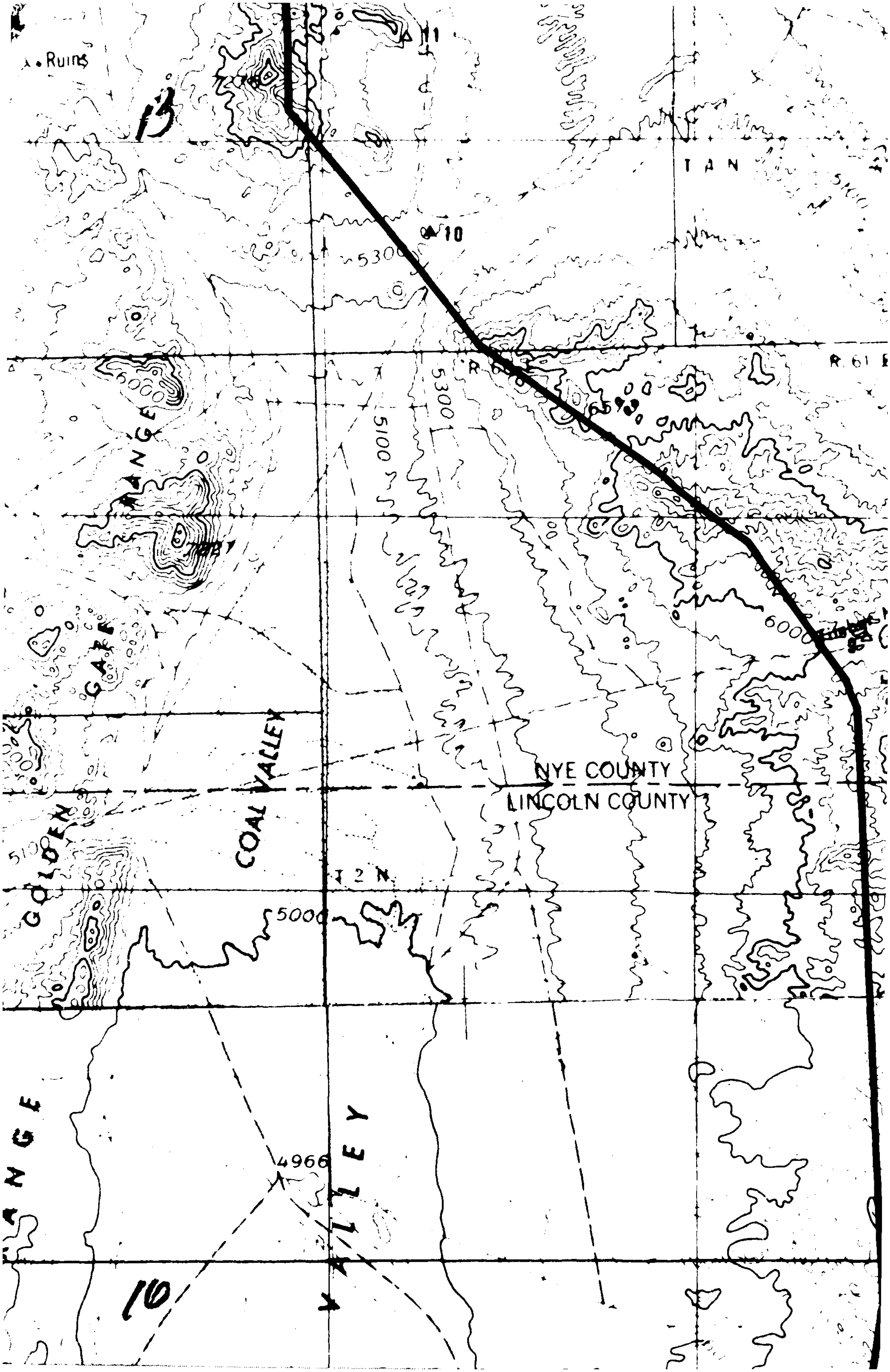
R
I
V
E
R
Ranch
Forest Moon Ranch
Ranch
Forest Home
(Ruins)
Sunnyside
5254
5300
6000
T 5 N
R 6 E
38
6
7
V
A
L
Ruins
34
32
29
70
31
37
36
48
11
73
26



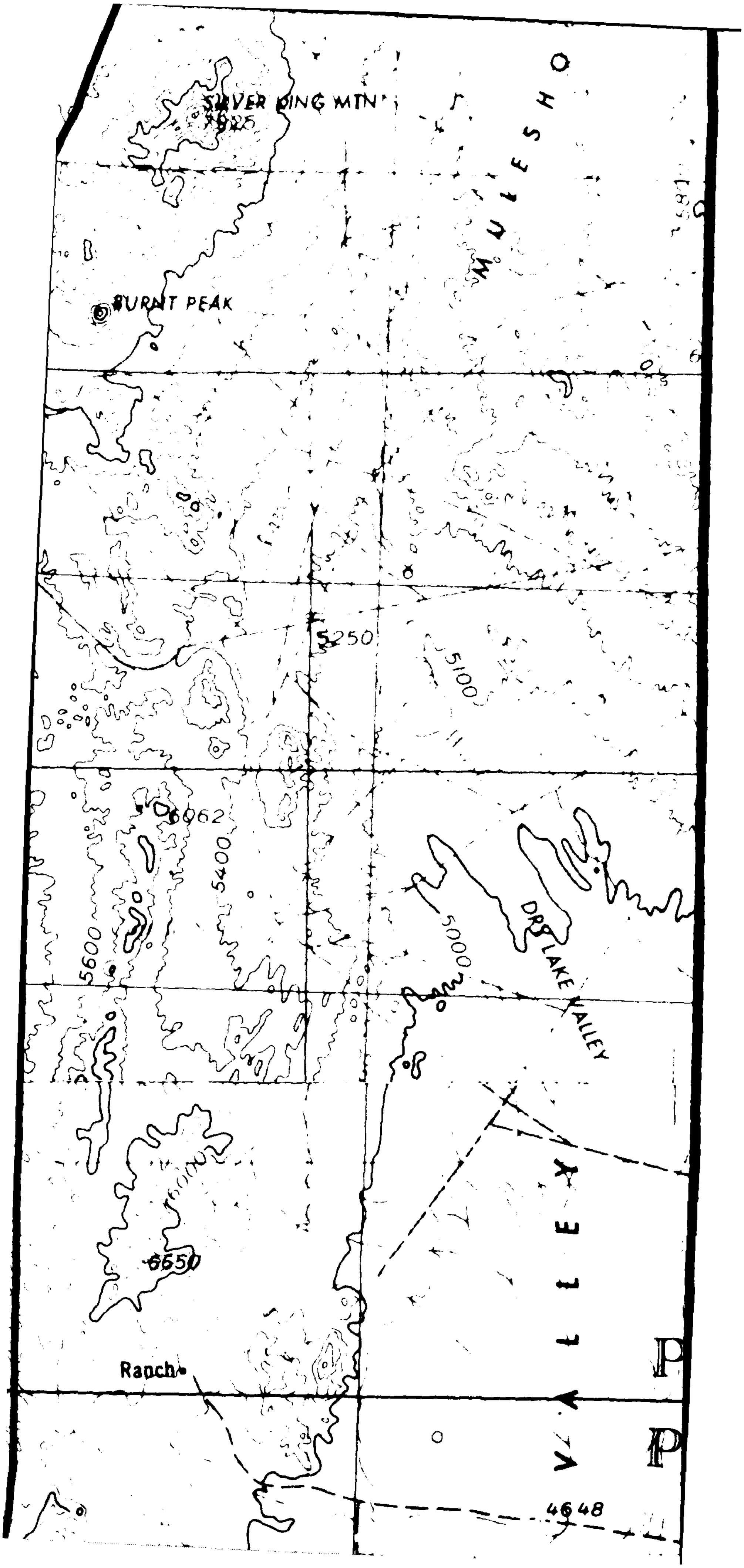
6005
6200
7000
450
440
Ranch
Water
Water
6000
R 63 E
R 64 E
NYE COUNTY
GAP MTN
74
6046
6400
5800
5657
IX MTN

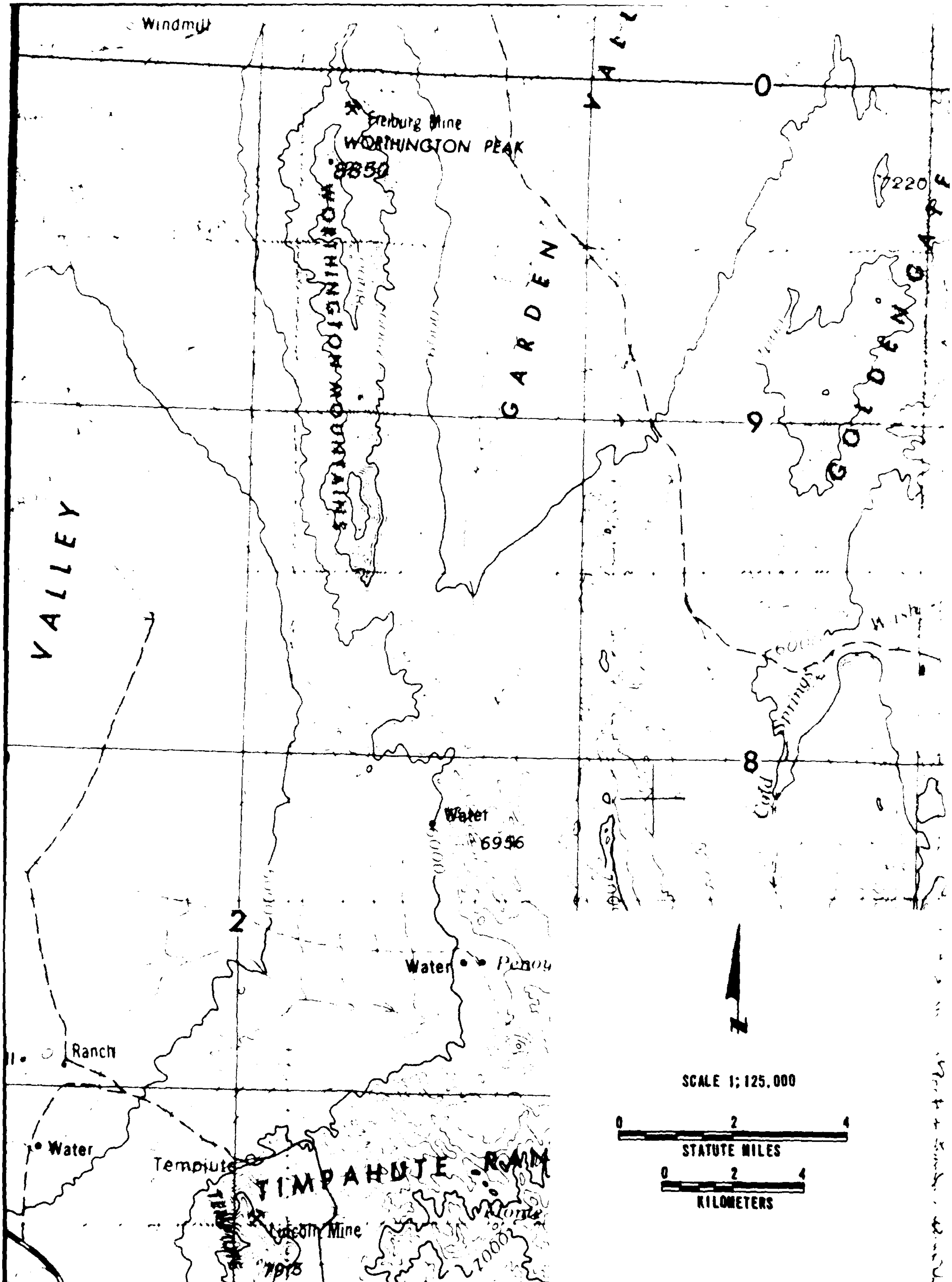


7000
8000
HUMBOLDT
NATIONAL FOREST
CHERRY CREEK SUMMIT
5384
3
Pumping station
Water
5300
Ranch
2
GARDEN VALLEY
6000
5242
7000
8000
Ranch
Ranch
Water
1
Water
5218
5600
OREST
VALLEY
Windmill
0
Freiburg Mine
WORTHINGTON PEAK
8850
7220

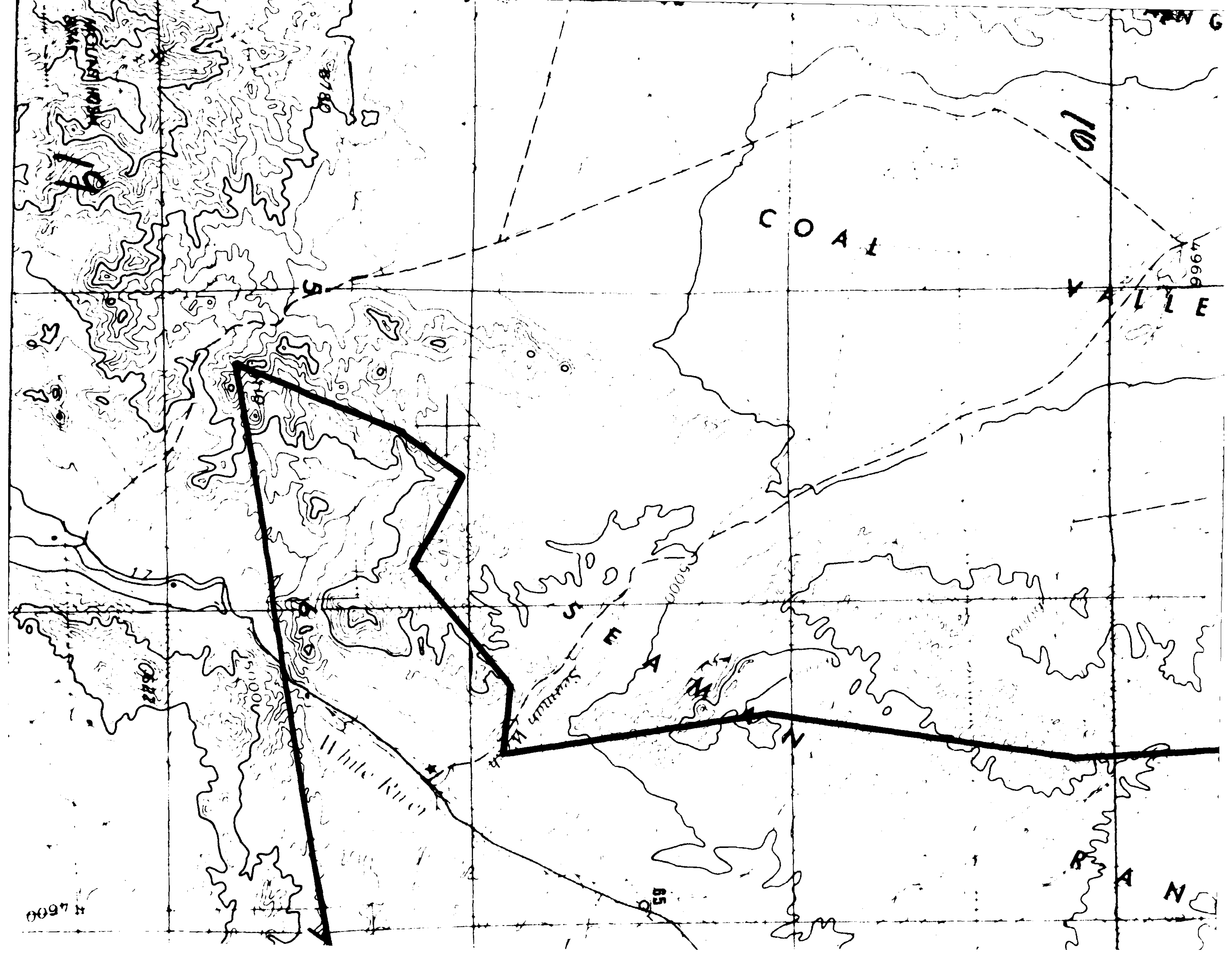


Ruins
13
11
10
5300
T A N
R 61 E
6000
5300
5100
RANGE
GOLDEN
GATE
COAL VALLEY
NYE COUNTY
LINCOLN COUNTY
T 2 N
5000
4966
VALLEY
RANGE
16

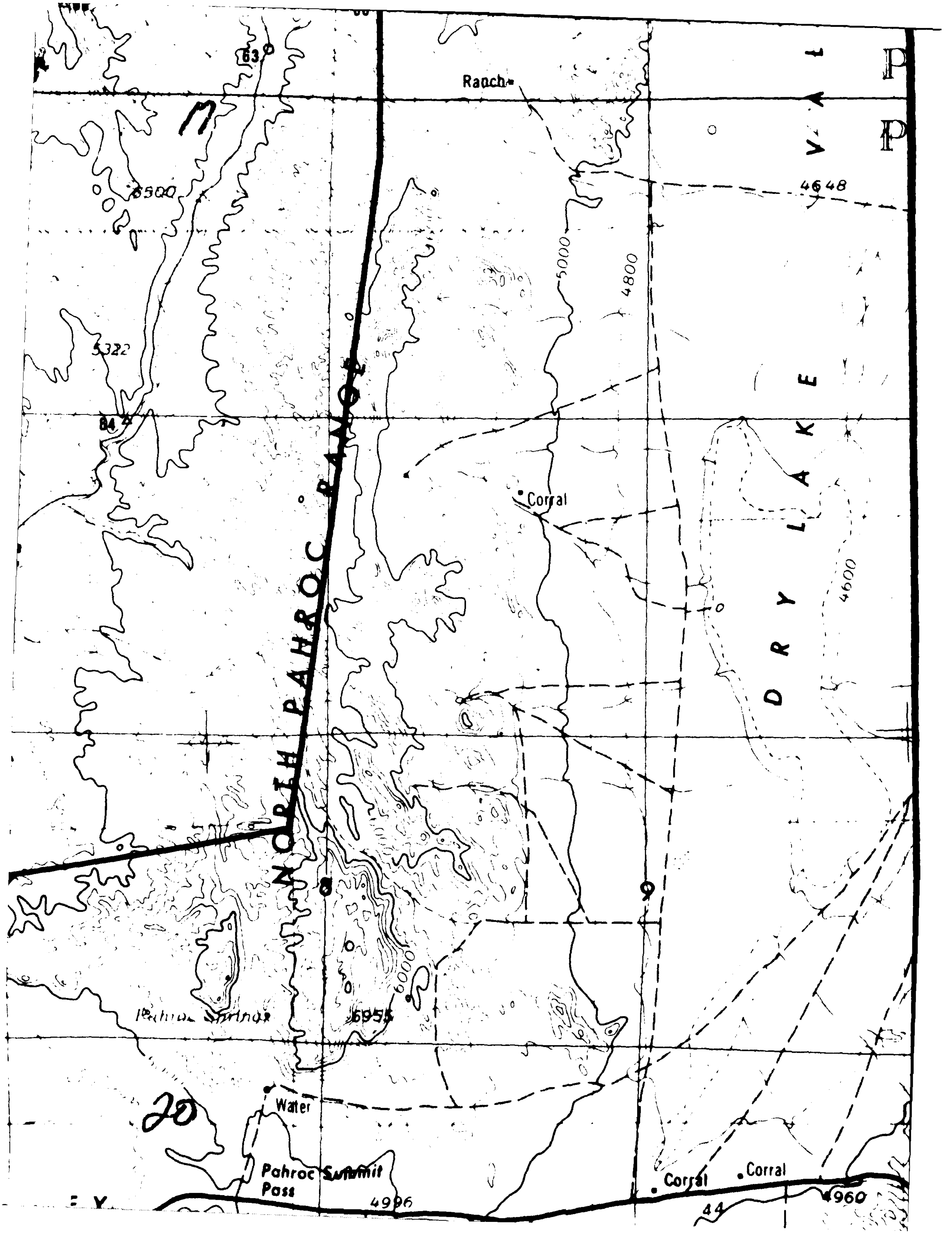

BURNT PEAK
MULESHOE
5250
5100
6062
5400
5600
5000
DRY LAKE VALLEY
6650
Ranch
VALLEY
4648
P
P



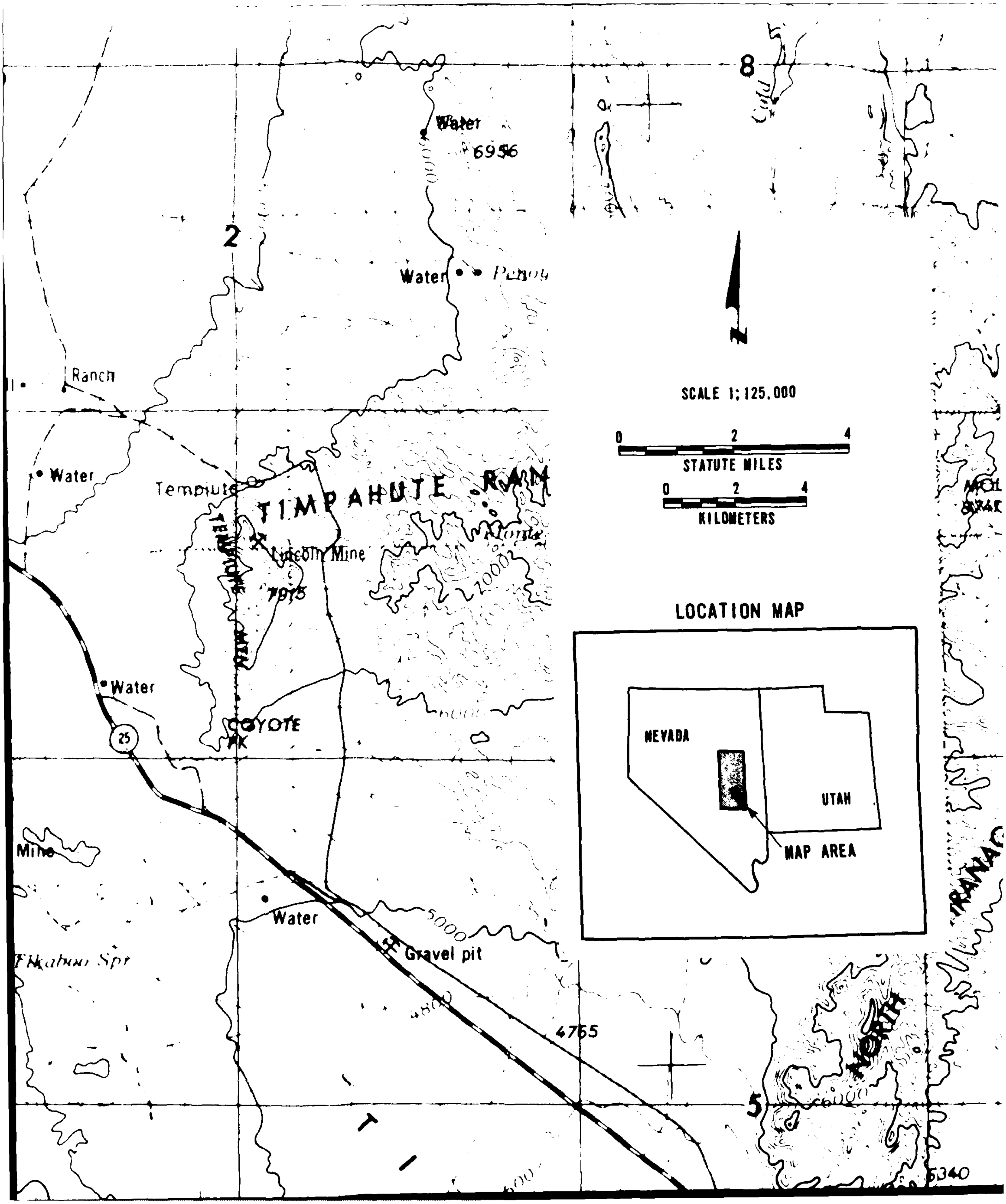
LOCATION MAP



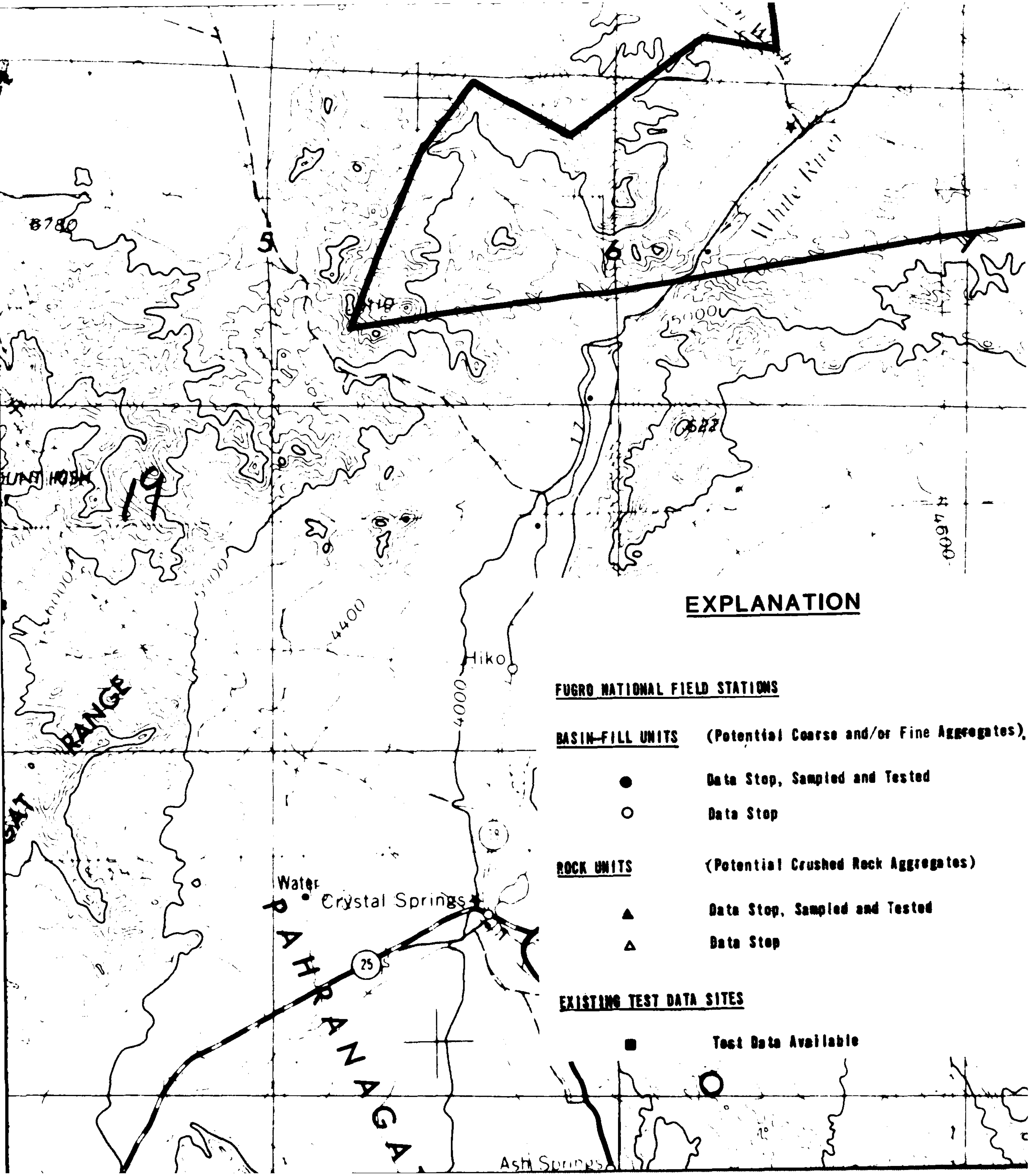
COAL
VALLE
SEAMAN
RAN
White River
10
19
5
6
4966
5000

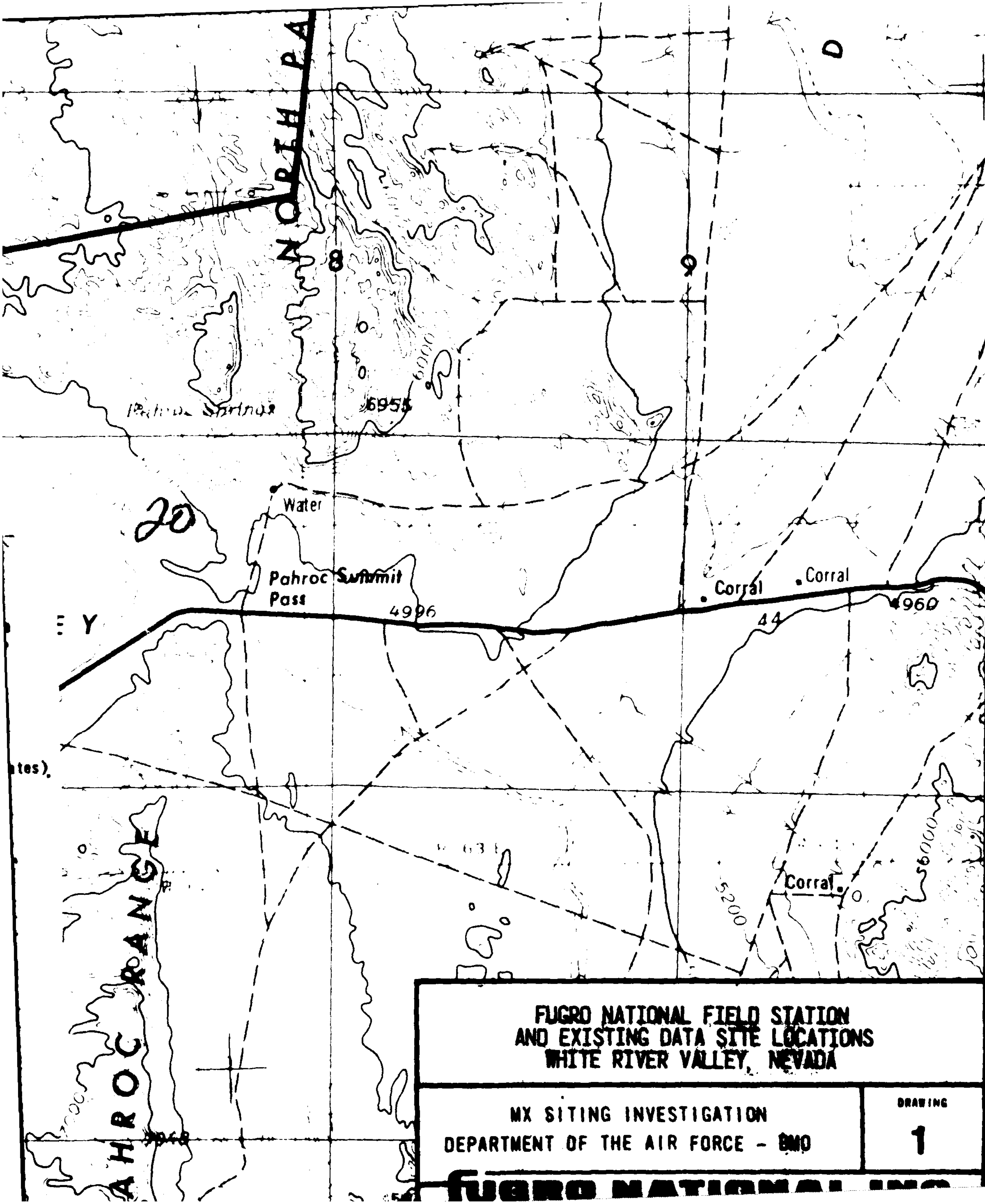


Ranch
63
6500
5322
84
NORTH PAHROC RANGE
5000
4800
4648
Corral
DRY LAKE VALLEY
4600
6000
6955
Water
Pahroc Summit Pass
Corral
Corral
4996
4960
44



8
Water
6956
2
Water
Ranch
Water
Tempiute
TIMPAHUTE RAN
Lincoln Mine
7915
COYOTE PK
Water
25
Mine
Water
5000
Gravel pit
4765
5
5340
NORTH
SCALE 1:125,000
0 2 4
STATUTE MILES
0 2 4
KILOMETERS
LOCATION MAP
NEVADA
UTAH
MAP AREA


White River
5
6
19
RANGE
PAHRANAGAT
Hiko
4400
4000
5000
Water
Crystal Springs
25
Ash Springs
EXPLANATION
FUGRO NATIONAL FIELD STATIONS
BASIN-FILL UNITS (Potential Coarse and/or Fine Aggregates)
Data Stop, Sampled and Tested
Data Stop
ROCK UNITS (Potential Crushed Rock Aggregates)
Data Stop, Sampled and Tested
Data Stop
EXISTING TEST DATA SITES
Test Data Available

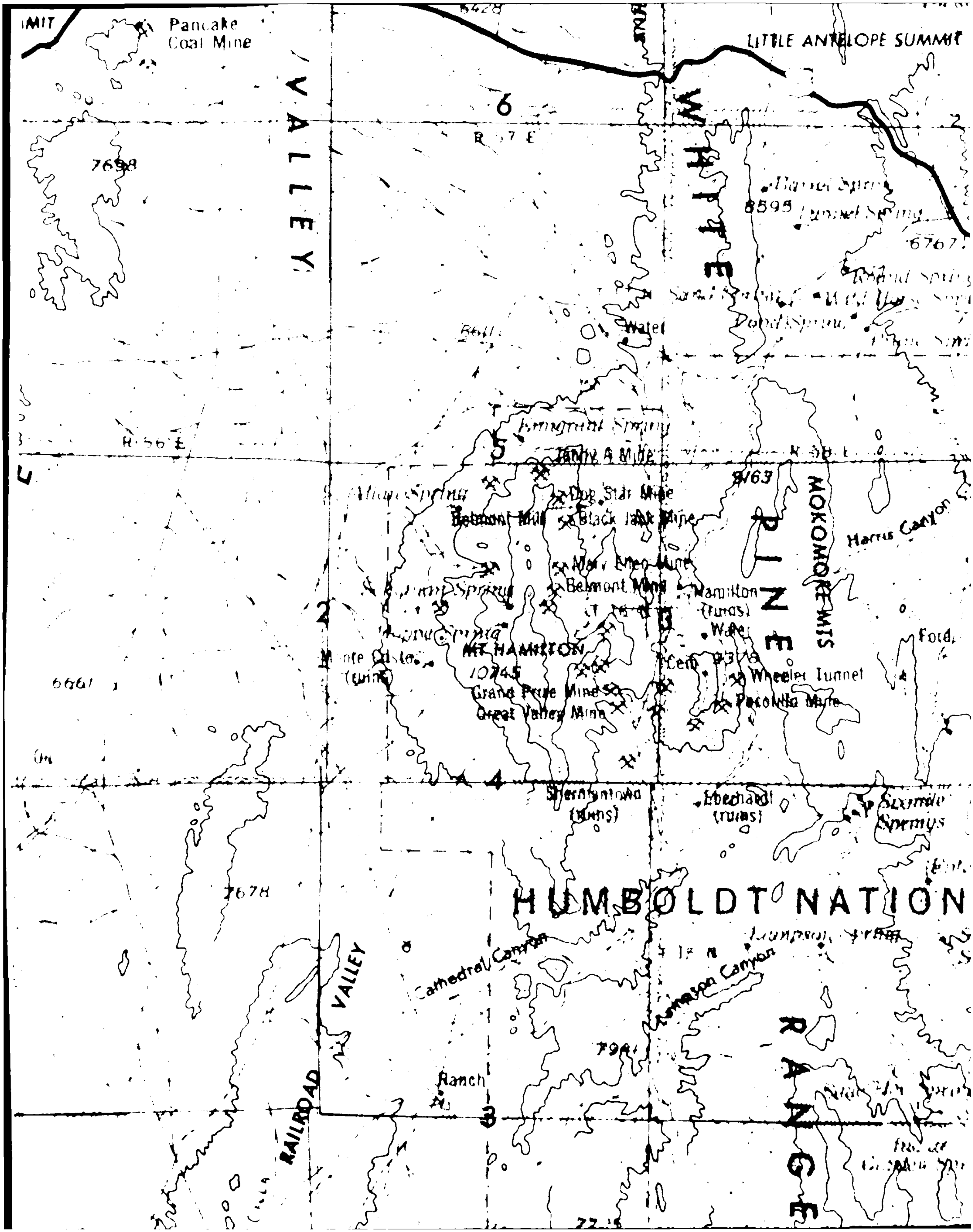


FUGRO NATIONAL FIELD STATION
AND EXISTING DATA SITE LOCATIONS
WHITE RIVER VALLEY, NEVADA

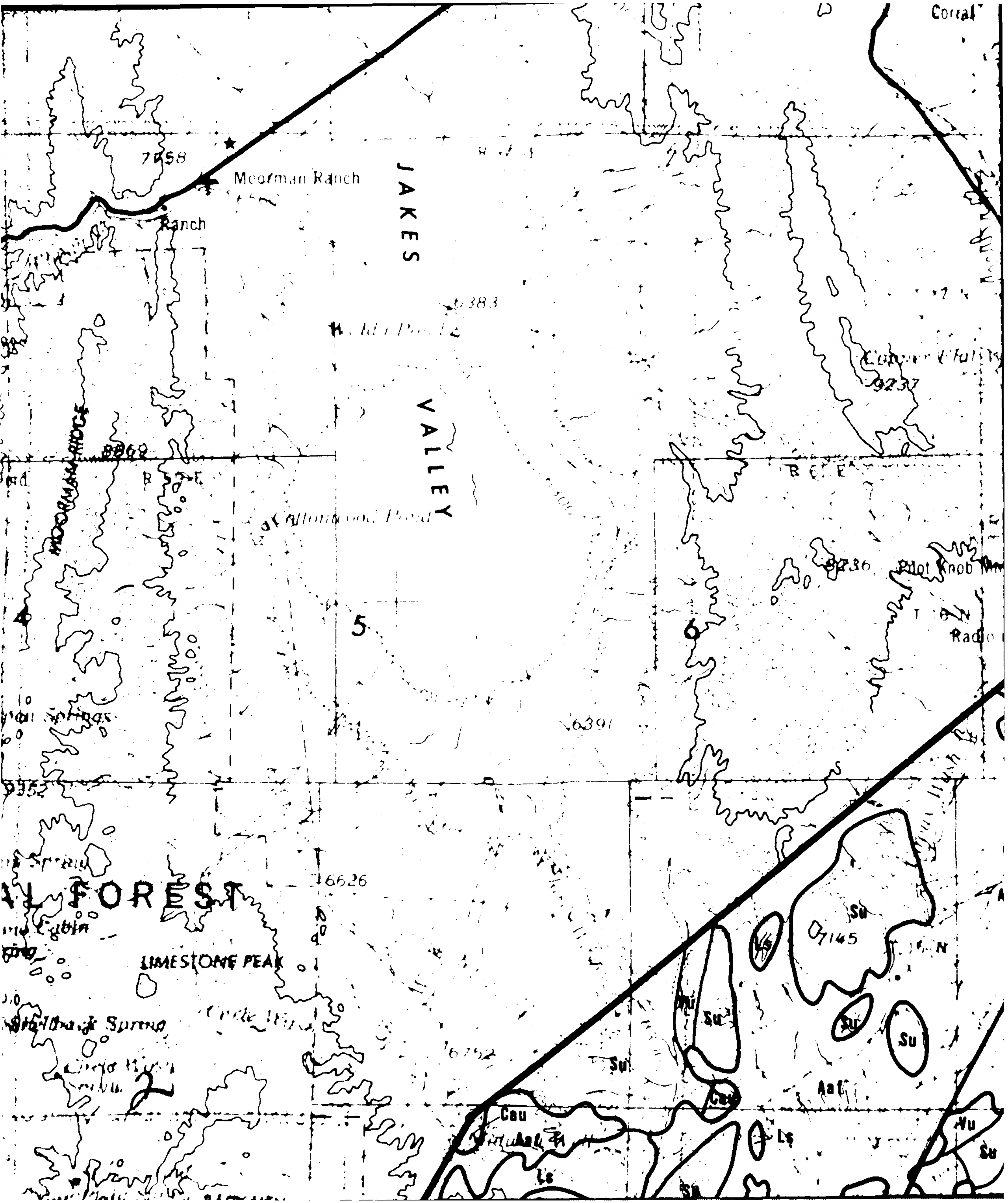
MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

DRAWING
1

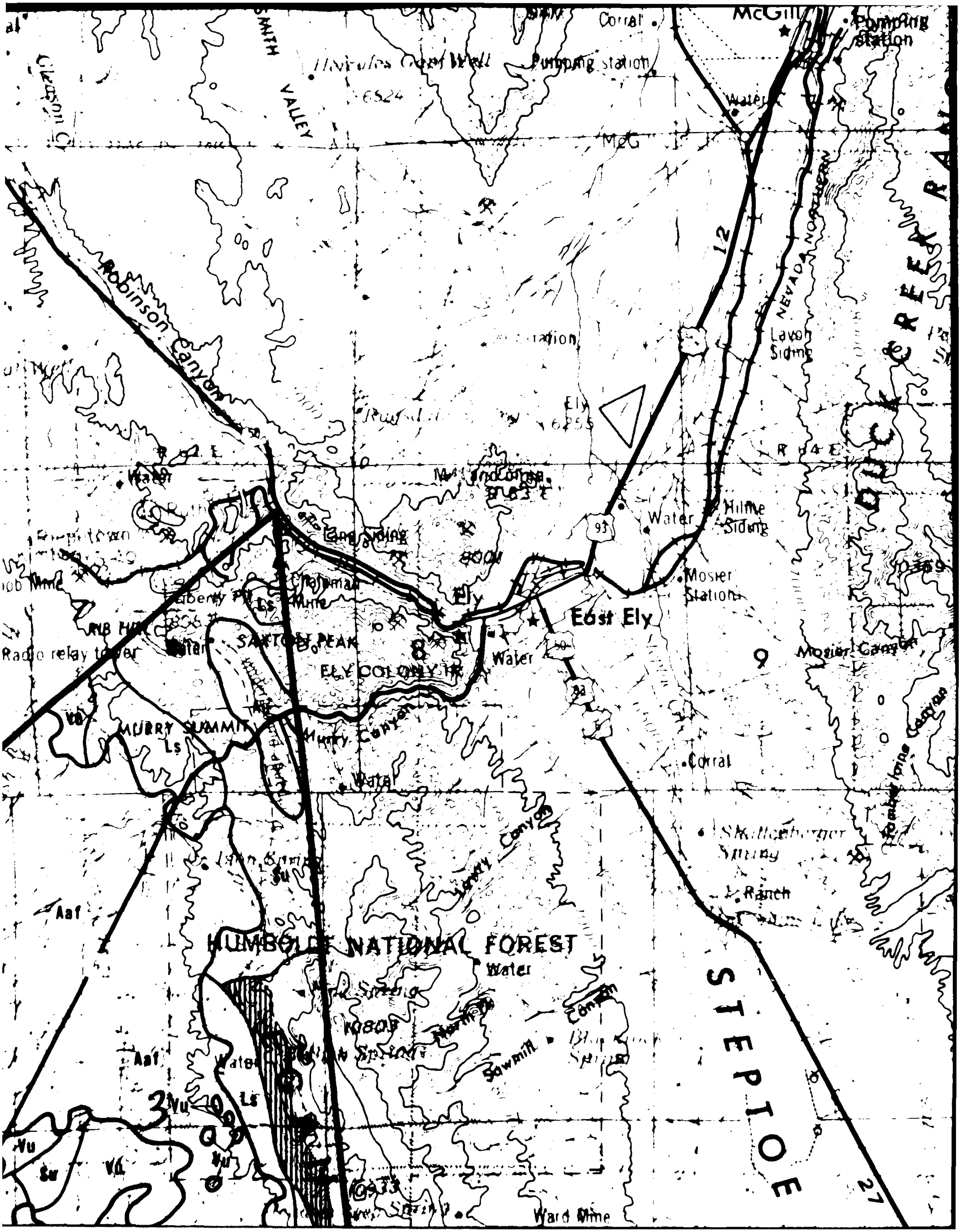
FUGRO NATIONAL, INC.



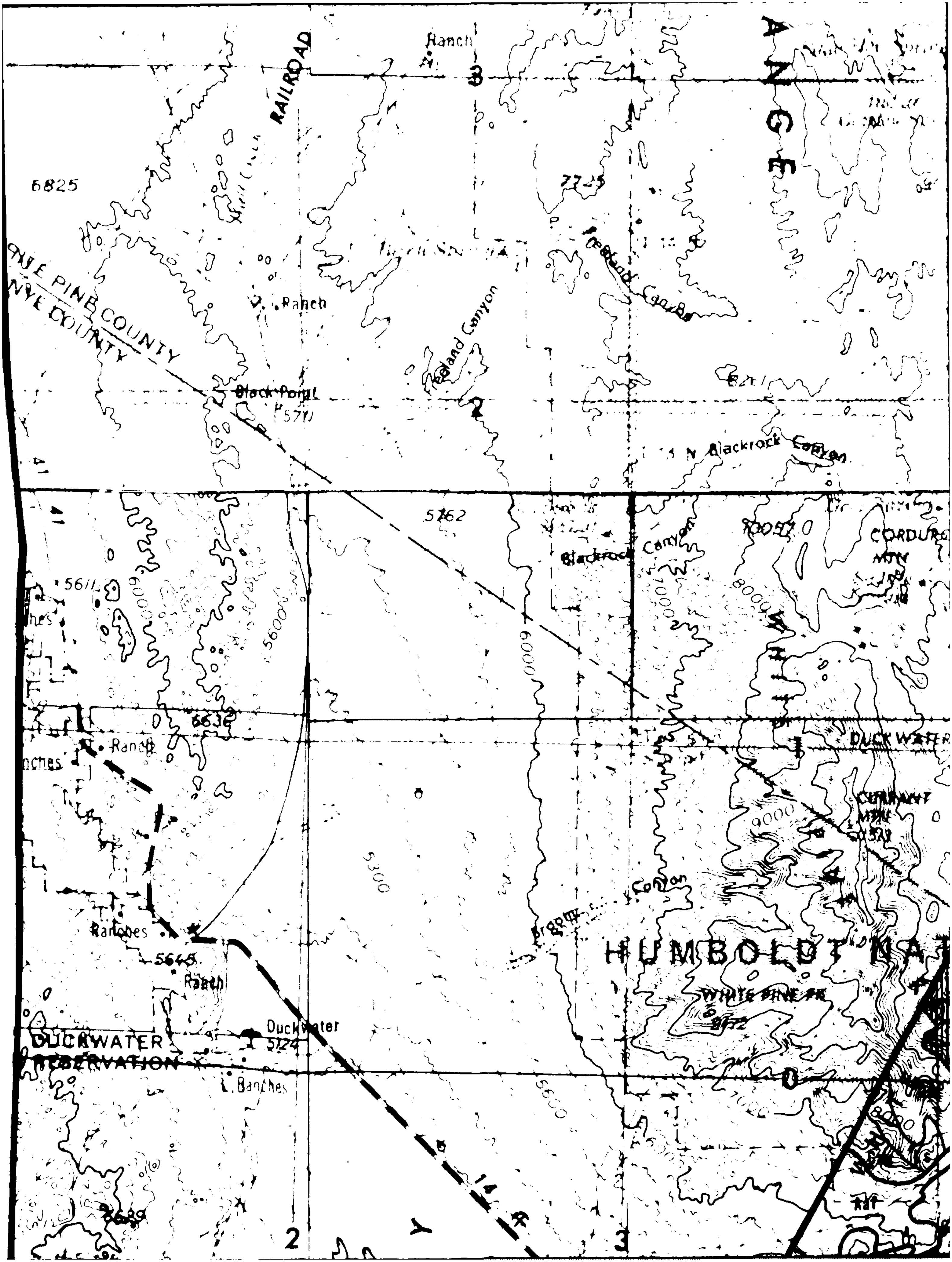
Pancake Coal Mine
LITTLE ANTELOPE SUMMIT
VALLEY
WHITE
PINE
MOKOMOKE MTS
Harris Canyon
Emigrant Spring
Dog Star Mine
Black Jack Mine
Belmont Mill
Mary Ellen Mine
Belmont Mine
Hamilton (ruins)
Water
MT HAMILTON
10745
Monte Cristo (ruins)
Wheeler Tunnel
Pocotillo Mine
Grand Prize Mine
Great Valley Mine
Cem
Shermantown (ruins)
Eberhardt (ruins)
HUMBOLDT NATION
Cathedral Canyon
Ranch
RAILROAD
VALLEY
RANGE
7698
8595
6661
7678

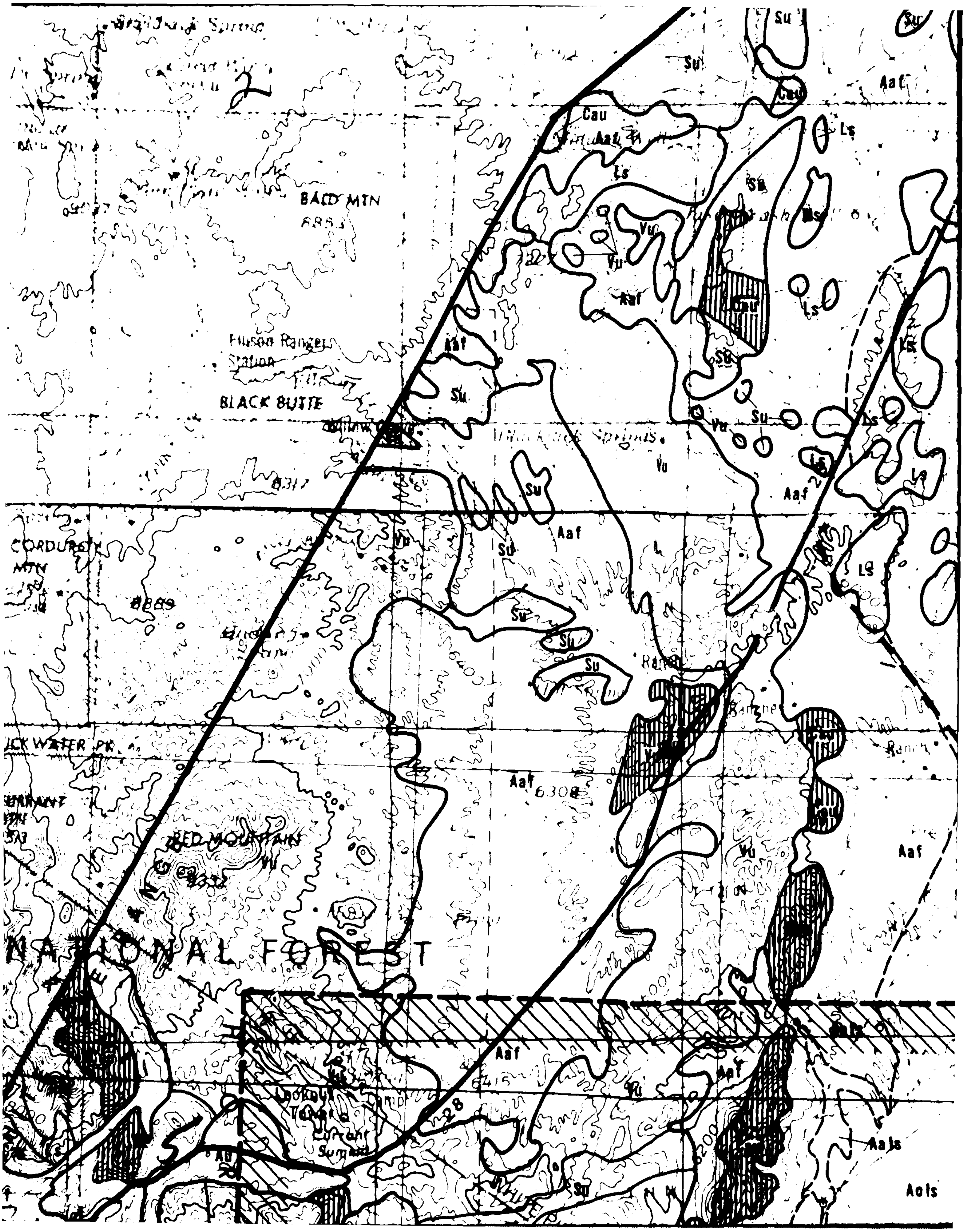


Corral
7258
Moorman Ranch
Ranch
JAKES
VALLEY
6383
MOORMAN RIDGE
8862
R 57 E
R 61 E
Cottonwood Pond
9237
9236
Pilot Knob
Radio
4
5
6
6391
9352
AL FOREST
6626
LIMESTONE PEAK
7145
Su
Ls
Su
Su
Su
Su
Aaf
Cau
Cau
Ls
Ls
Vu
Su
2

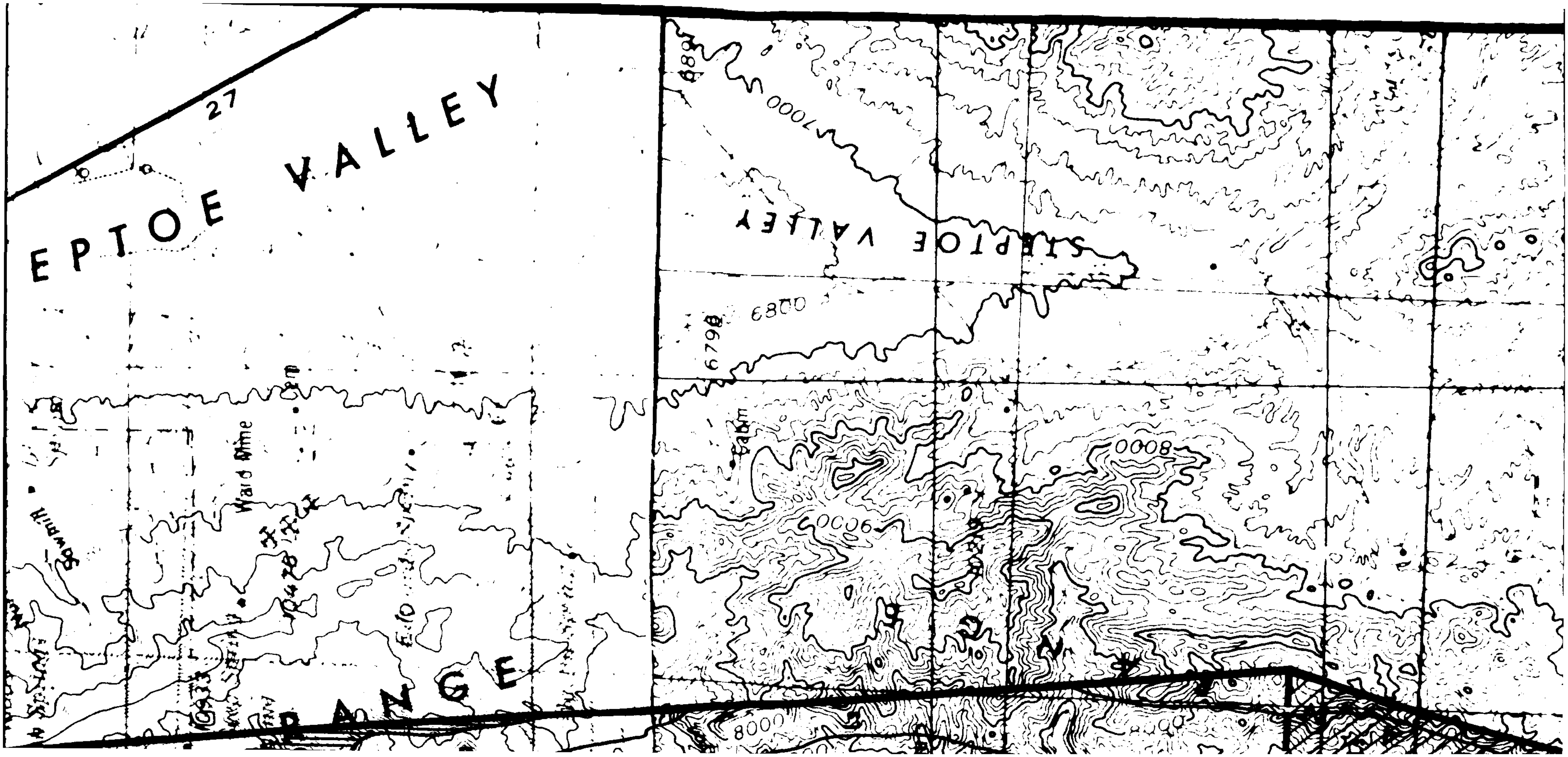


McGill
Pumping Station
Corral
Pumping station
VALLEY
Robinson Canyon
Lavon Siding
NEVADA NORTHERN
DUCK CREEK RANGE
Ely
East Ely
Water
Hiline Siding
Mosier Station
Mosier Canyon
Chapman
Lane Siding
SANTON PEAK
ELY COLONY IR
Radio relay tower
MURRY SUMMIT
Murry Canyon
Corral
Ranch
HUMBOLDT NATIONAL FOREST
Water
Sawmill
Canyon
STEPTOE
Ward Mine
Aaf
Ls
Su
Nu
Vu

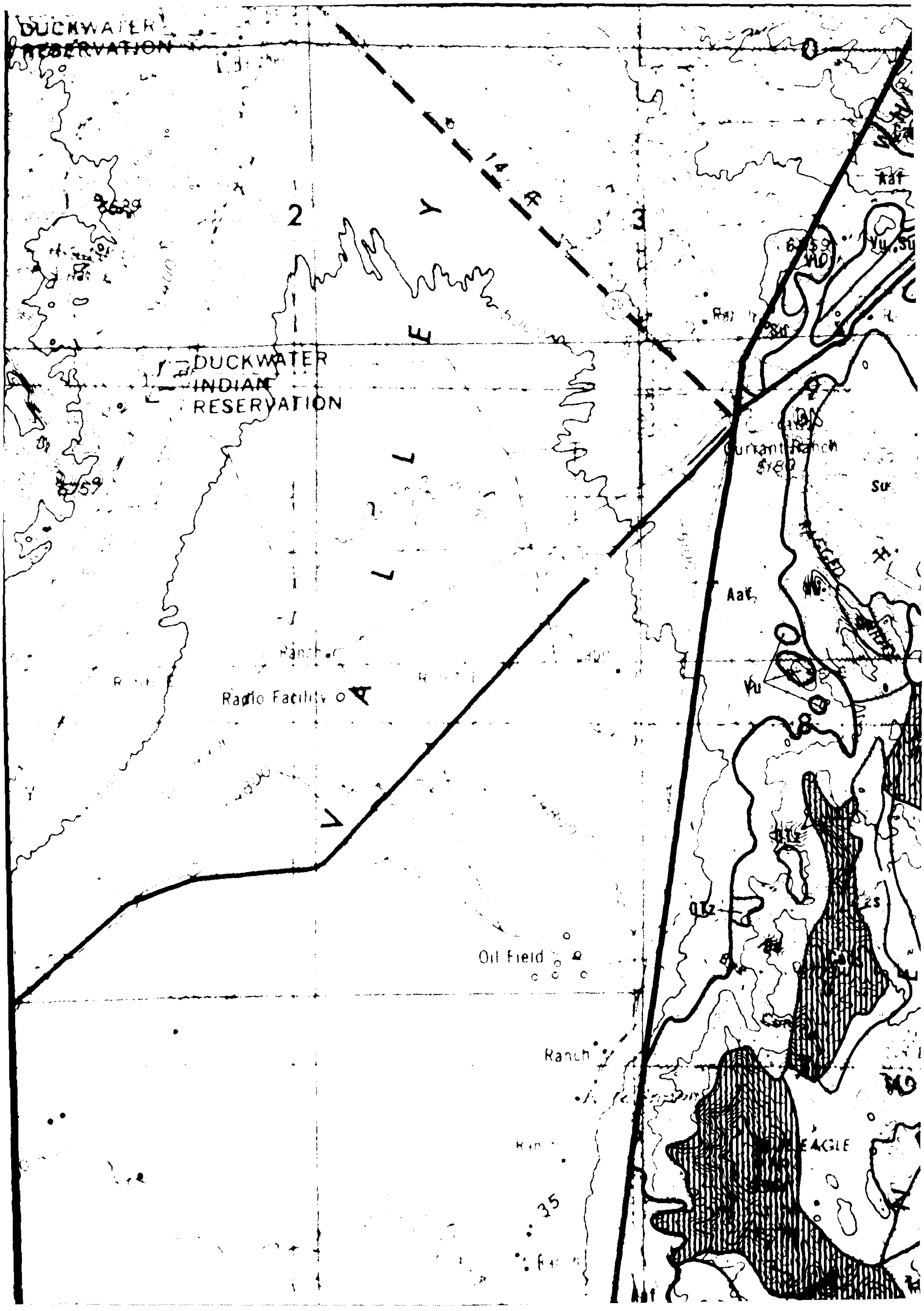

RAILROAD
Ranch
3
6825
WHITE PINE COUNTY
NYE COUNTY
Ranch
Freeland Canyon
Black Point
2
Blackrock Canyon
5762
Blackrock Canyon
CORDUROY
MTN
5611
6000
5600
7000
8000
6636
Ranch
DUCKWATER
CURRANT
MTN
9000
5300
Canyon
Ranches
5645
Ranch
HUMBOLDT NAT
WHITE PINE PK
Duckwater
5124
DUCKWATER
RESERVATION
Ranches
5600
7000
8000
2
3



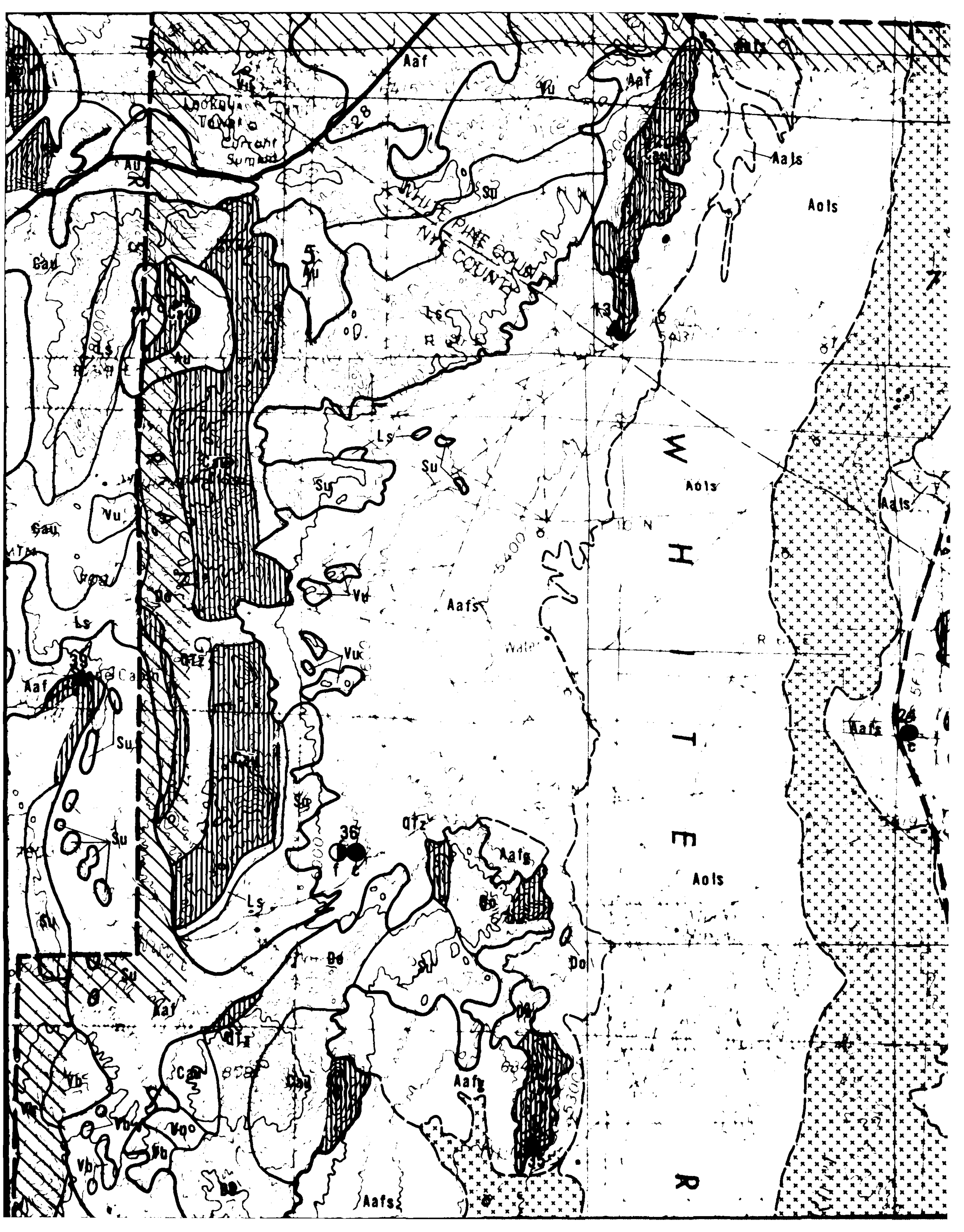
BALD MTN
Huson Ranger Station
BLACK BUTTE
CORDUROY MTN
RED MOUNTAIN
NATIONAL FOREST
Aaf
Su
Cau
Ls
Vu
6308
6415
Aals
Aols



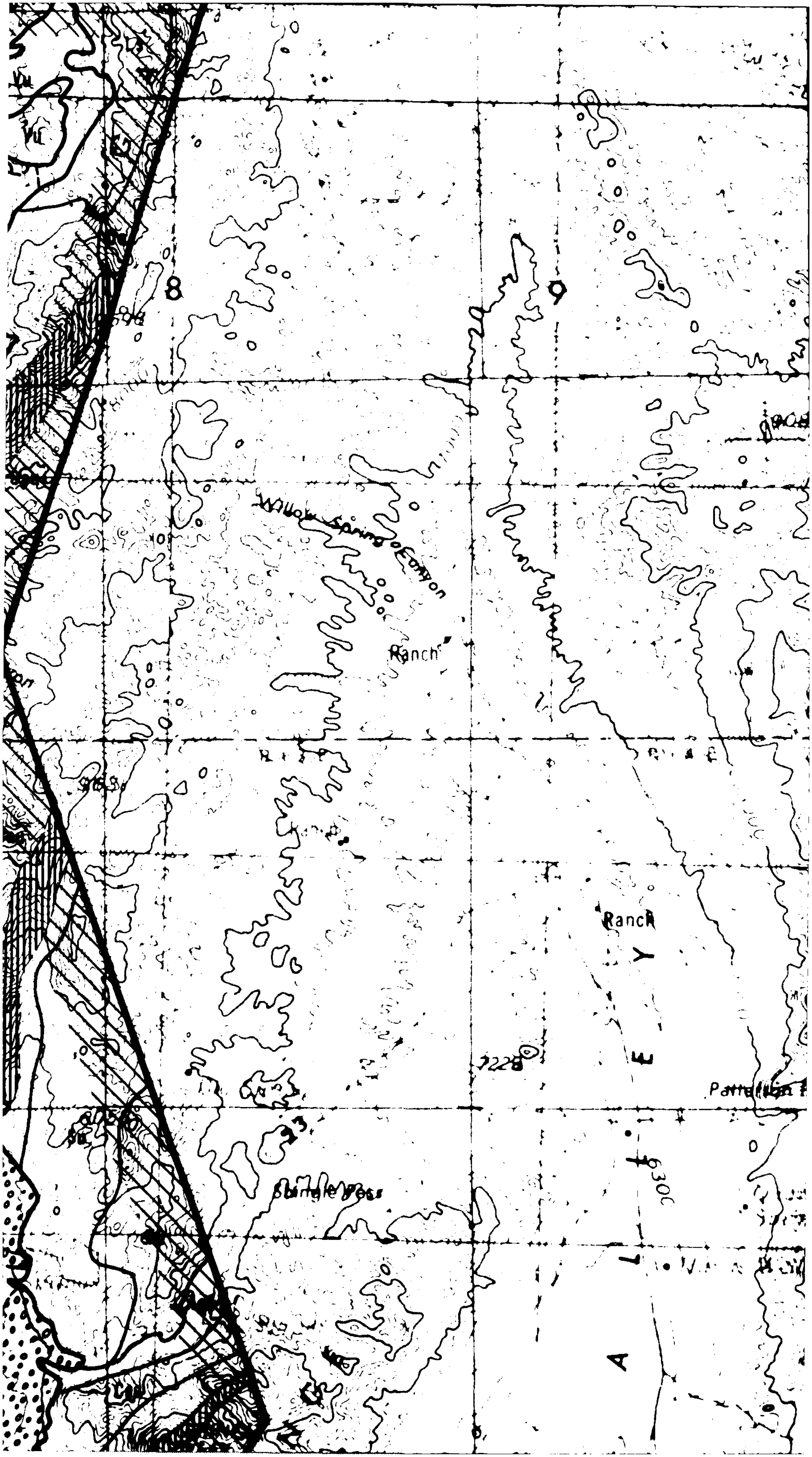
EPTOE VALLEY
27
Sawmill
Ward Mine
Cem
10933
10478
RANGE
Cabin
6790
6800
7000
9000
8000
STEPTOE VALLEY



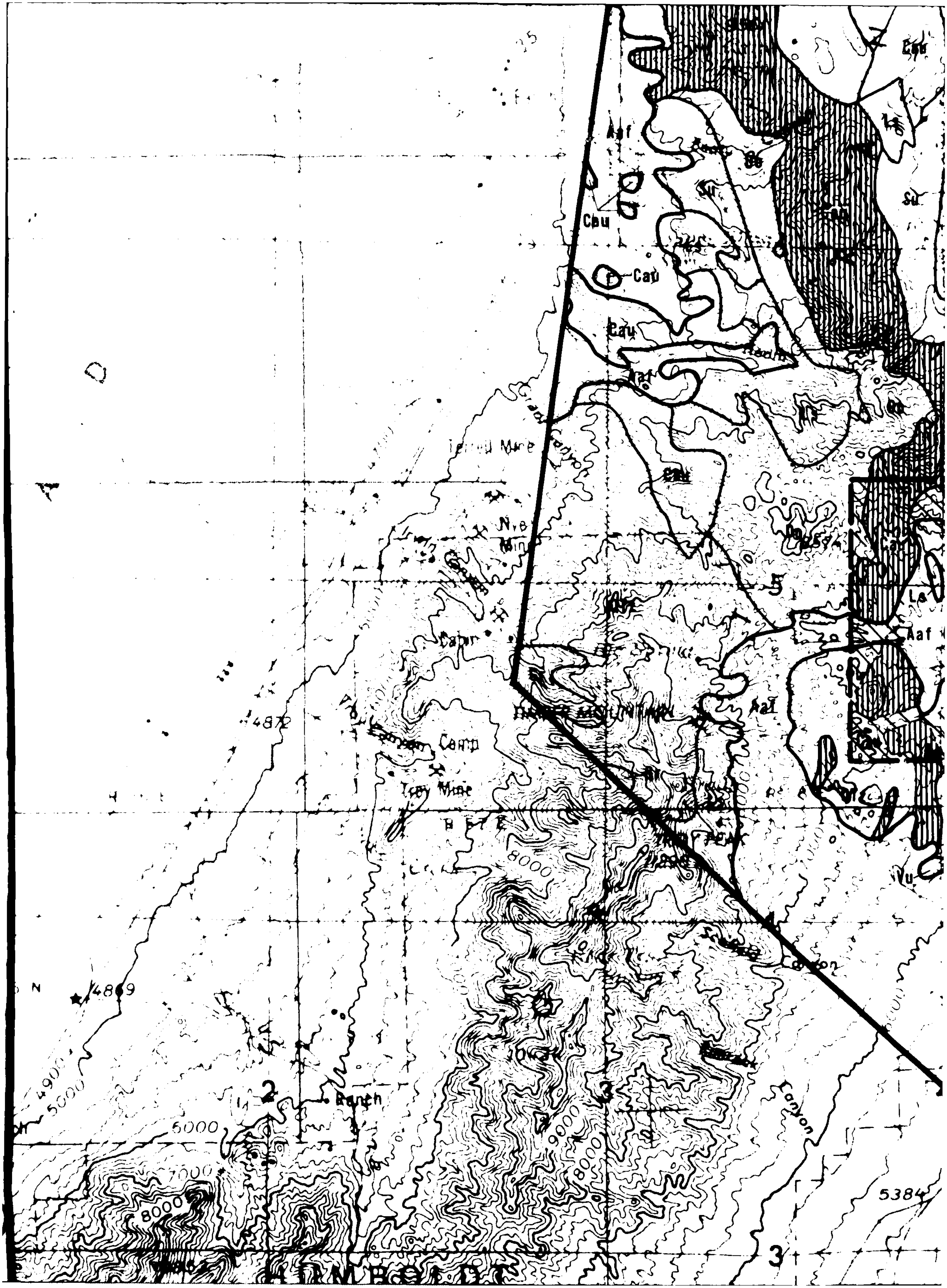
DUCKWATER
RESERVATION
2
3
Y
E
DUCKWATER
INDIAN
RESERVATION
L
L
A
V
Radio Facility
Ranch
Oil Field
Ranch
35
Aaf
Su
Vu
EAGLE



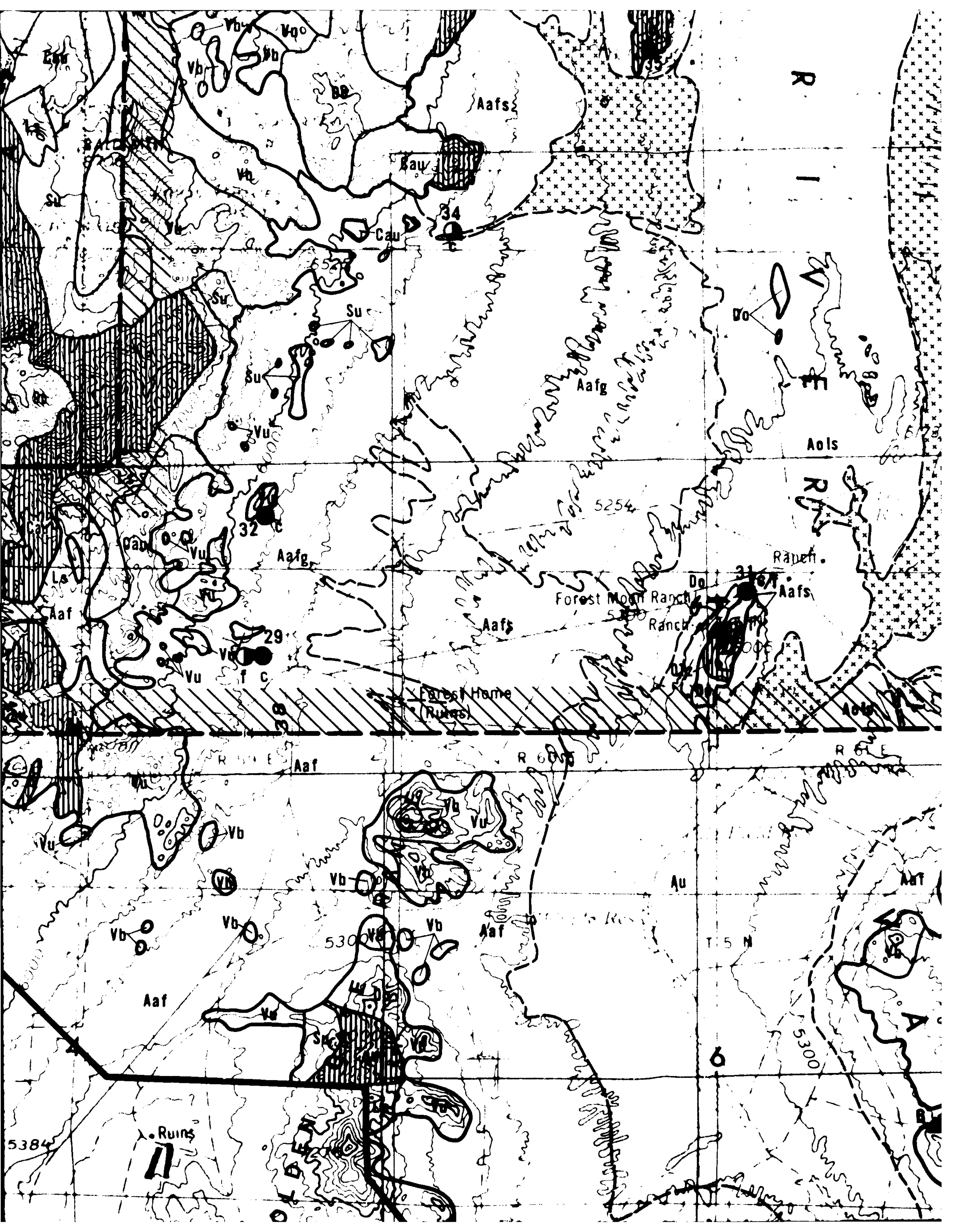
Aaf
Vu
Aals
Aols
WHITE PINE COUNTY
NYE COUNTY
Su
Au
Gau
Ls
Aafs
Qfz
Do
Vb
Vo
Cau
28
39
36
13
24
WHITE R



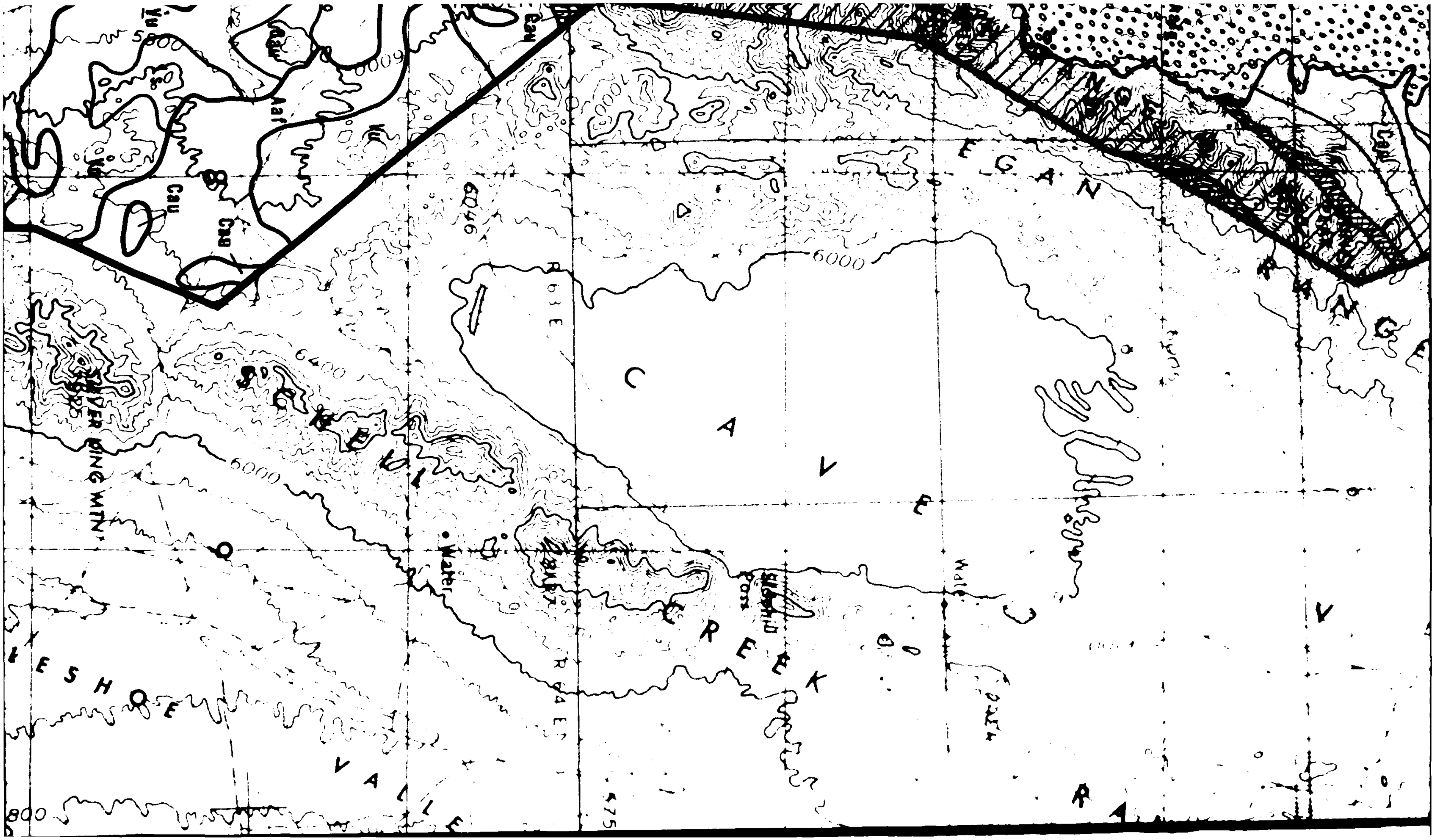
8
9
Willow Spring Canyon
Ranch
Ranch
7228
Pattaflan
Shingle Pass
6300
V
A
L
L
E
Y

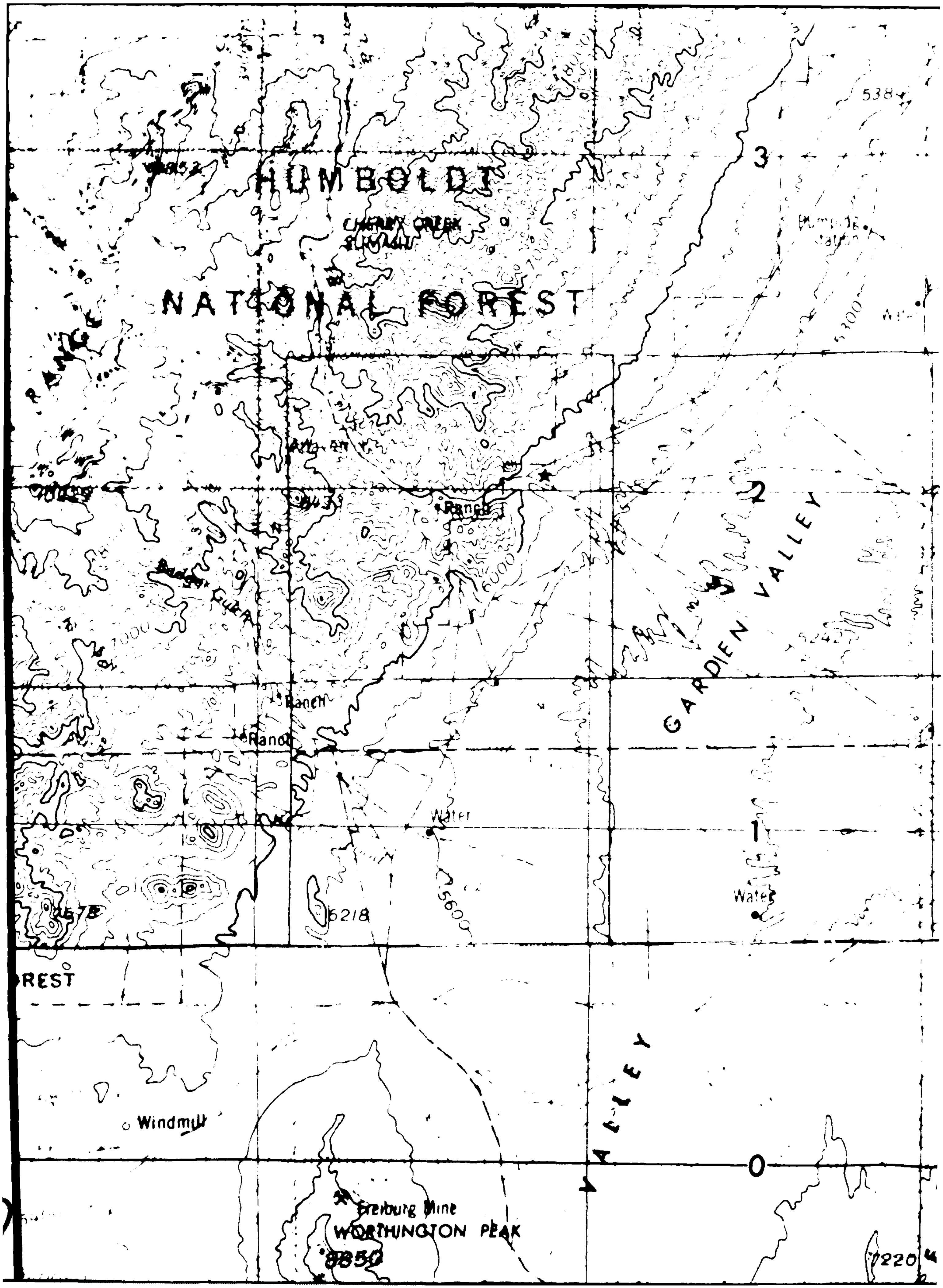


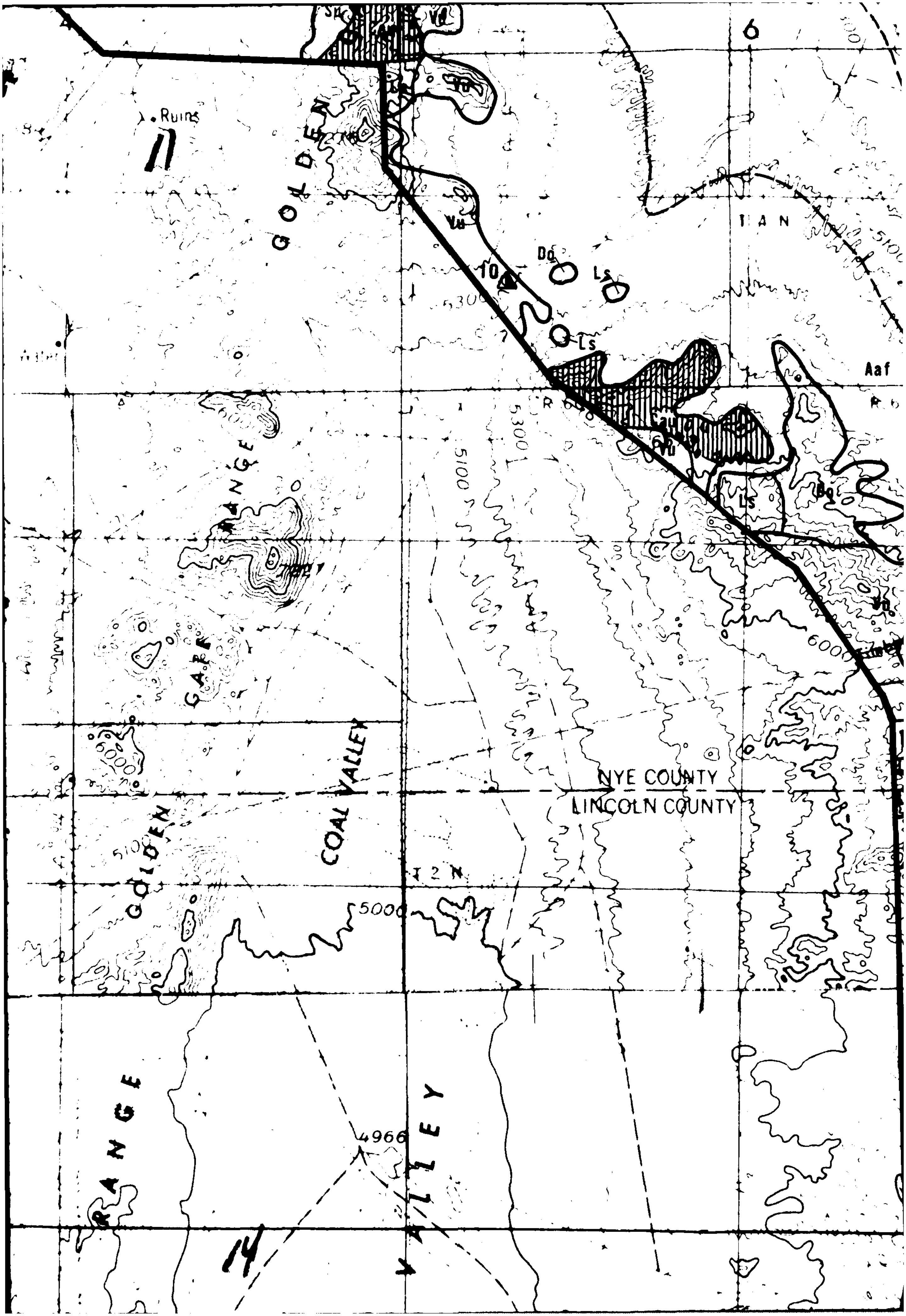
Cau
Aaf
Sd
Camp
Troy Mine
Canyon
Ranch
La
4872
4869
5384
4900
5000
6000
7000
8000
9000



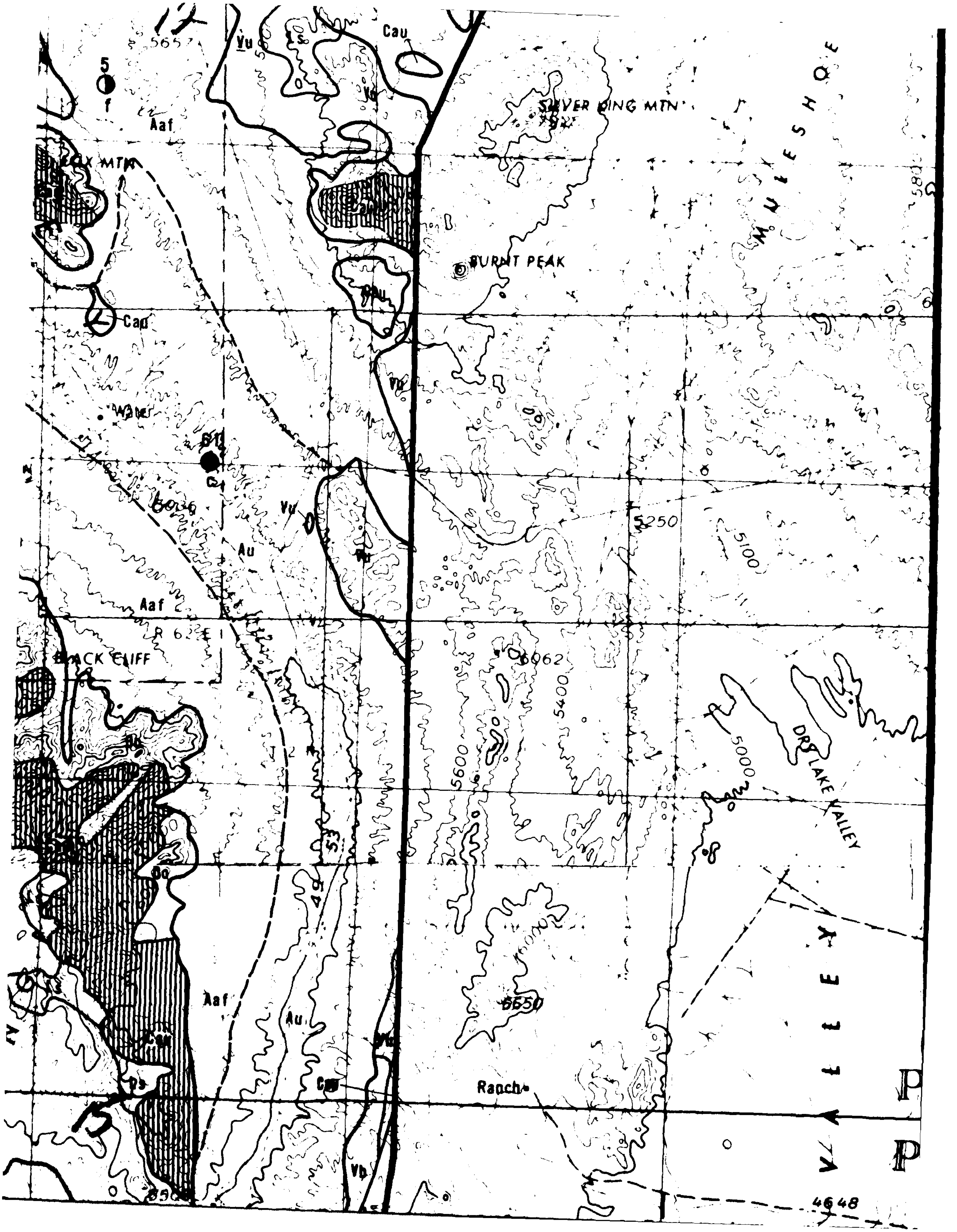
Vb
Vq
Cau
Aafs
Bau
34
c
Cau
Su
Su
Vu
Do
Aafg
Aols
5254
32
c
Aafg
Vu
Ranch
Forest Moon Ranch
Aafs
Ranch
Aaf
29
Vu
f
c
Forest Home
(Ruins)
Aols
R 6 E
Aaf
Vb
Vu
Au
Aaf
5300
T 5 N
Vu
6
5300
Ruins
5384


EGAN RANGE
CAVE
CREEK
CAVE VALLEY
SILVER KING MTN
Water
Cau
Aaf
Vu
6000
6046
6400
5800
R 63 E
R 64 E

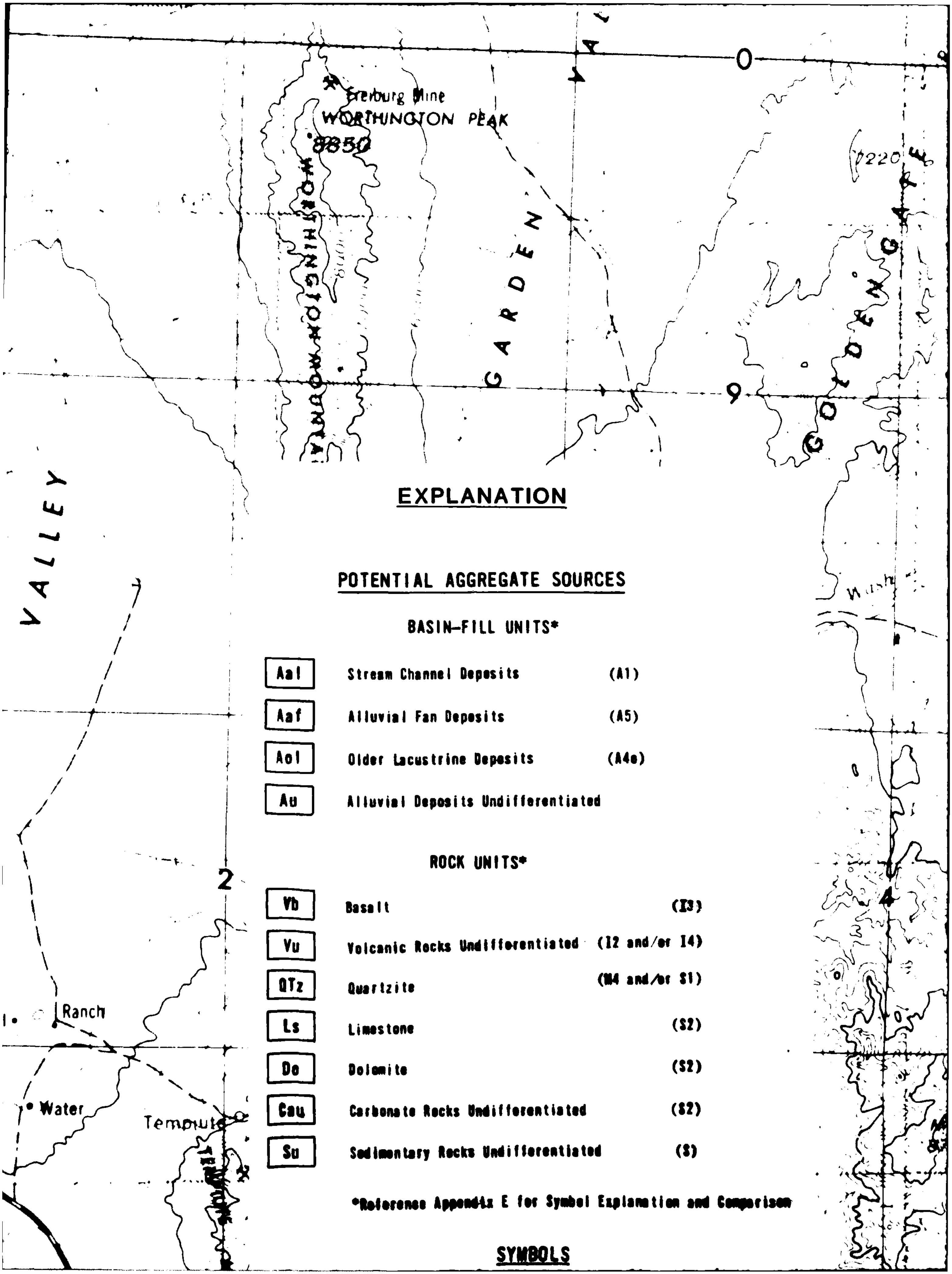

HUMBOLDT
NATIONAL FOREST
CHERRY CREEK SUMMIT
GARDEN VALLEY
VALLEY
Ranch
Ranch
Ranch
Water
Water
5384
6000
5600
5242
6218
Windmill
Freiburg Mine
WORTHINGTON PEAK
8850
7220
REST
3
2
1
0



Ruins
GOLDEN
GOLD
RANGE
GAP
GOLDEN
COAL VALLEY
NYE COUNTY
LINCOLN COUNTY
T 2 N
5000
5100
5300
6000
4966
RANGE
VALLEY
Vu
Dg
Ls
Aaf
11
14
6



Cau
Vu
Aaf
PEAK MTN
SILVER KING MTN
MULESHOE
BURNT PEAK
Cau
Water
Vu
5250
5100
Au
Aaf
R 62 E
BLACK CLIFF
6062
5400
5000
DRY LAKE VALLEY
5600
53
49
Aaf
Au
5650
Vu
Ranch
VALLEY
Vb
4648



EXPLANATION

POTENTIAL AGGREGATE SOURCES

BASIN-FILL UNITS*

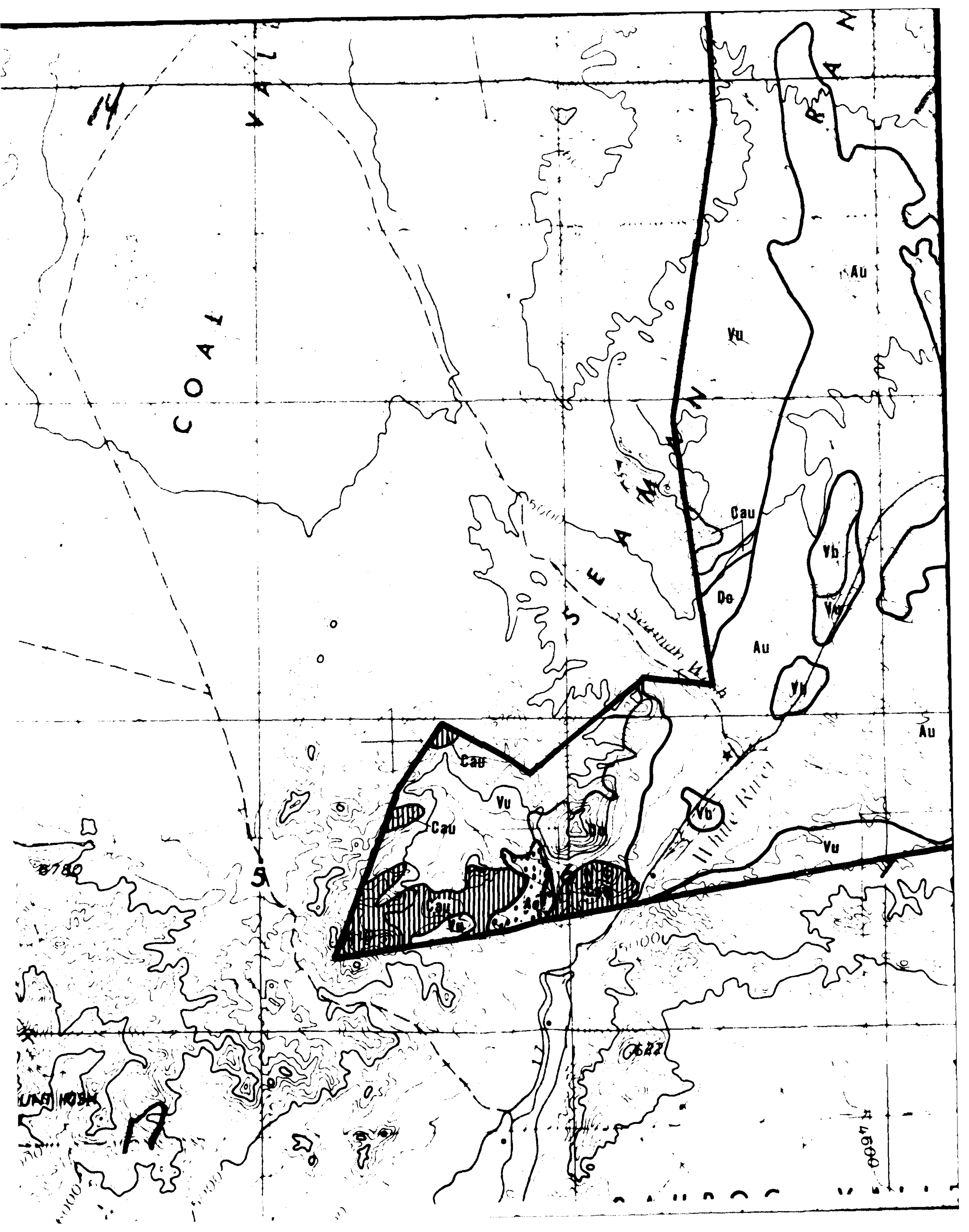
Aal	Stream Channel Deposits	(A1)
Aaf	Alluvial Fan Deposits	(A5)
Aol	Older Lacustrine Deposits	(A4e)
Au	Alluvial Deposits Undifferentiated	

ROCK UNITS*

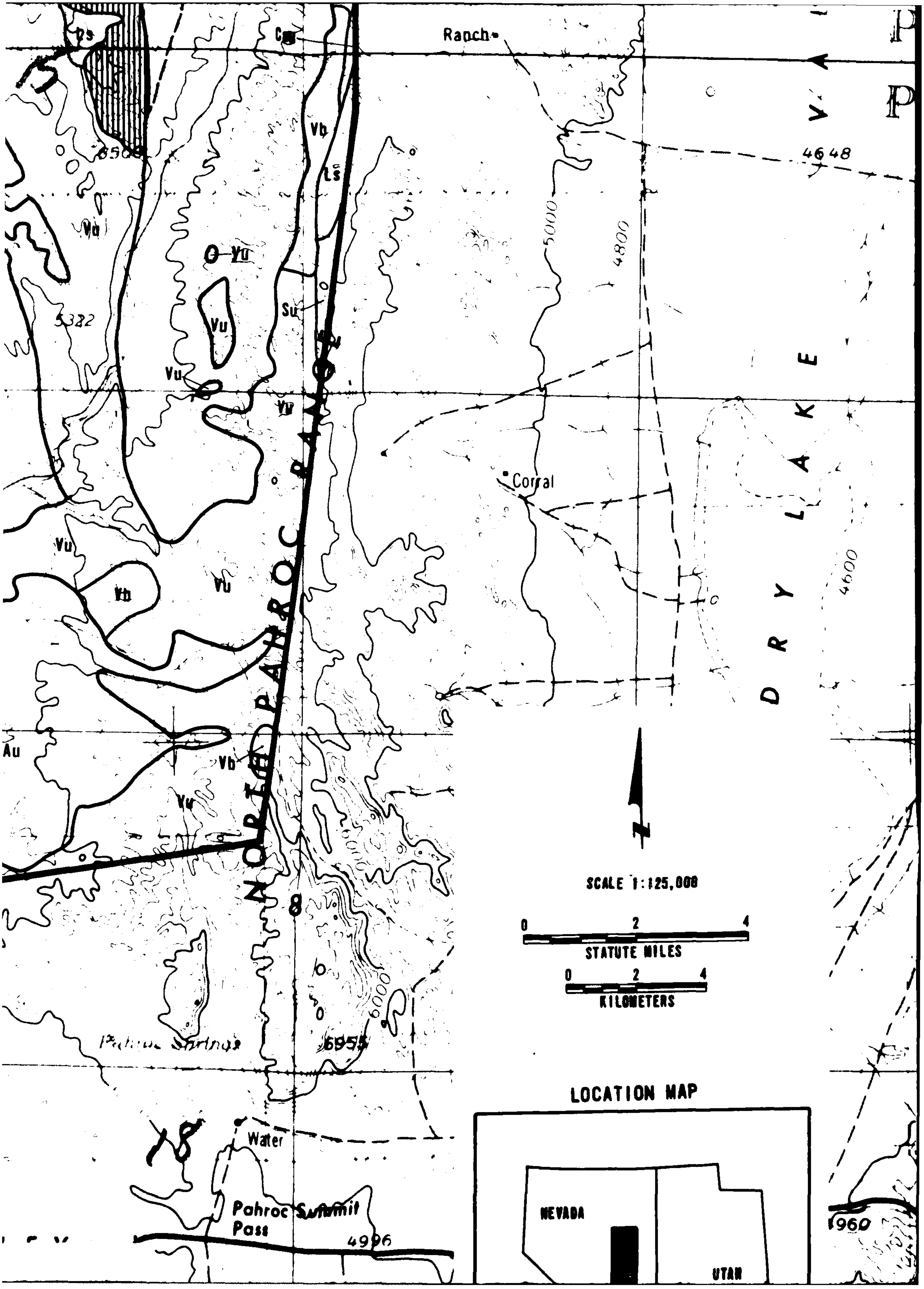
Vb	Basalt	(I3)
Vu	Volcanic Rocks Undifferentiated	(I2 and/or I4)
QTz	Quartzite	(M4 and/or S1)
Ls	Limestone	(S2)
Do	Dolomite	(S2)
Cau	Carbonate Rocks Undifferentiated	(S2)
Su	Sedimentary Rocks Undifferentiated	(S)

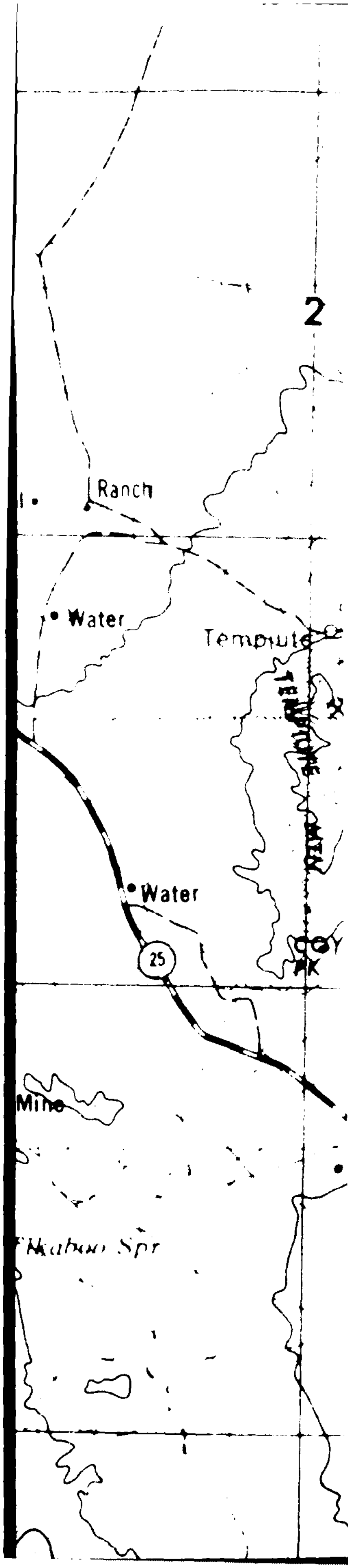
*Reference Appendix E for Symbol Explanation and Comparison

SYMBOLS



COAL VAL
SEAMAN
RAN
Cau
Vu
Au
Vb
De
White River
Seaman Wash
14
5
8780
4600


Ranch
Corral
DRY LAKE
NORTH PAHROC RANGE
Vu
Vb
Su
Ls
Au
5322
5000
4800
4648
4600
6000
5955
Water
Pahroc Summit Pass
4996
1960
SCALE 1:125,000
0 2 4
STATUTE MILES
0 2 4
KILOMETERS
LOCATION MAP
NEVADA
UTAH



Aal	Stream Channel Deposits	(A1)
Aaf	Alluvial Fan Deposits	(A5)
Aol	Older Lacustrine Deposits	(A4e)
Au	Alluvial Deposits Undifferentiated	

ROCK UNITS*

Vb	Basalt	(I3)
Vu	Volcanic Rocks Undifferentiated	(I2 and/or I4)
QTz	Quartzite	(M4 and/or S1)
Ls	Limestone	(S2)
Do	Dolomite	(S2)
Cau	Carbonate Rocks Undifferentiated	(S2)
Su	Sedimentary Rocks Undifferentiated	(S)

*Reference Appendix E for Symbol Explanation and Comparison

SYMBOLS

Aafg — Material type (Aaf) and Grain Size Designation (g) Grain size designations are gravel (g) and sand (s) and are assigned only in Verification Study Areas

Geologic Contact, Dashed Where Approximate

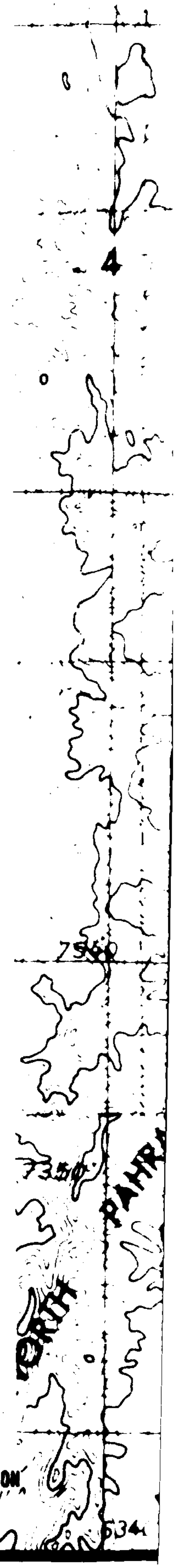
Approximate Concrete Aggregate and/or Road-Base Materials Source Boundary

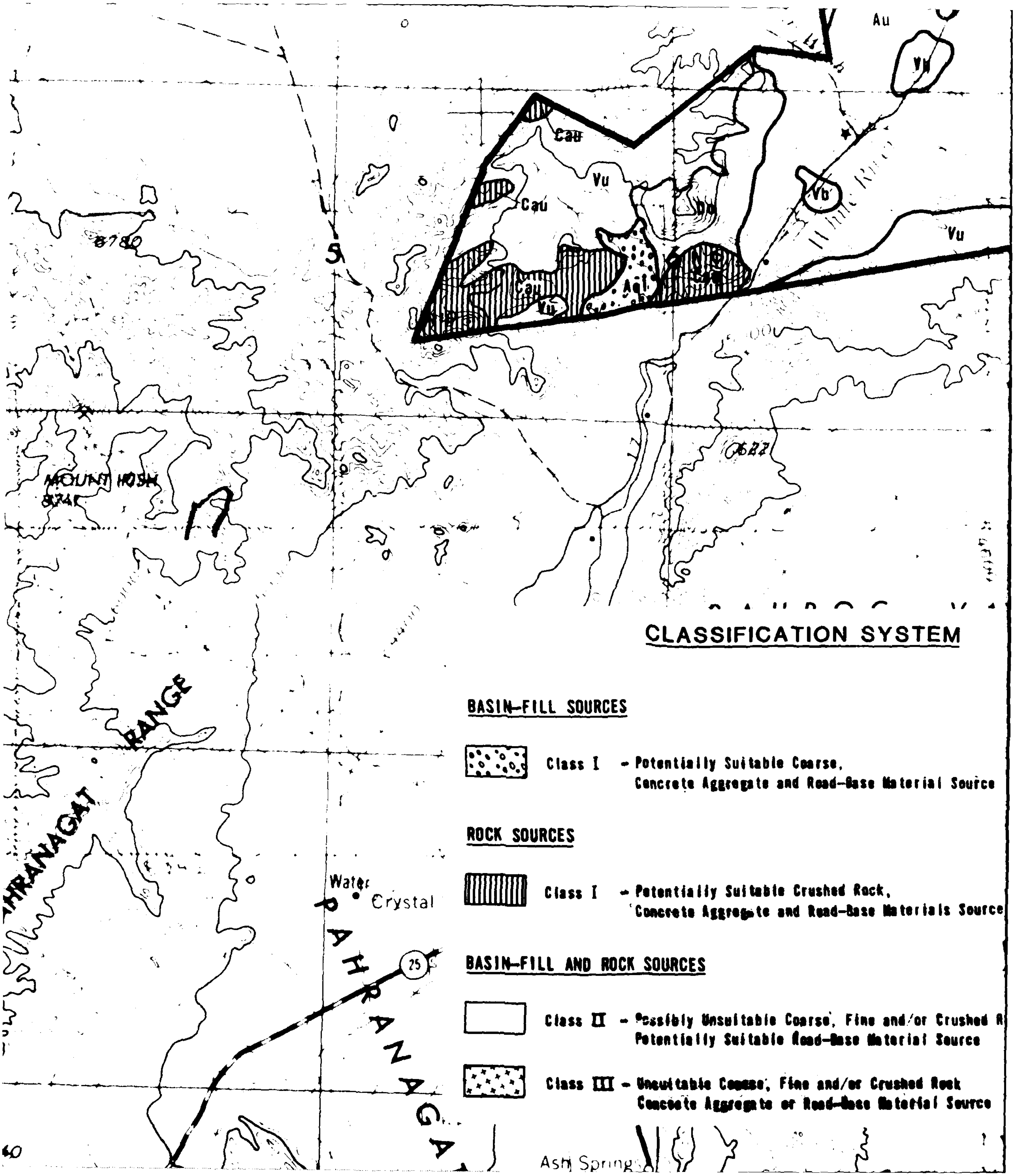
Verification Study Area

FUGRO NATIONAL AGGREGATE RESOURCES SAMPLED AND TESTED FIELD STATIONS

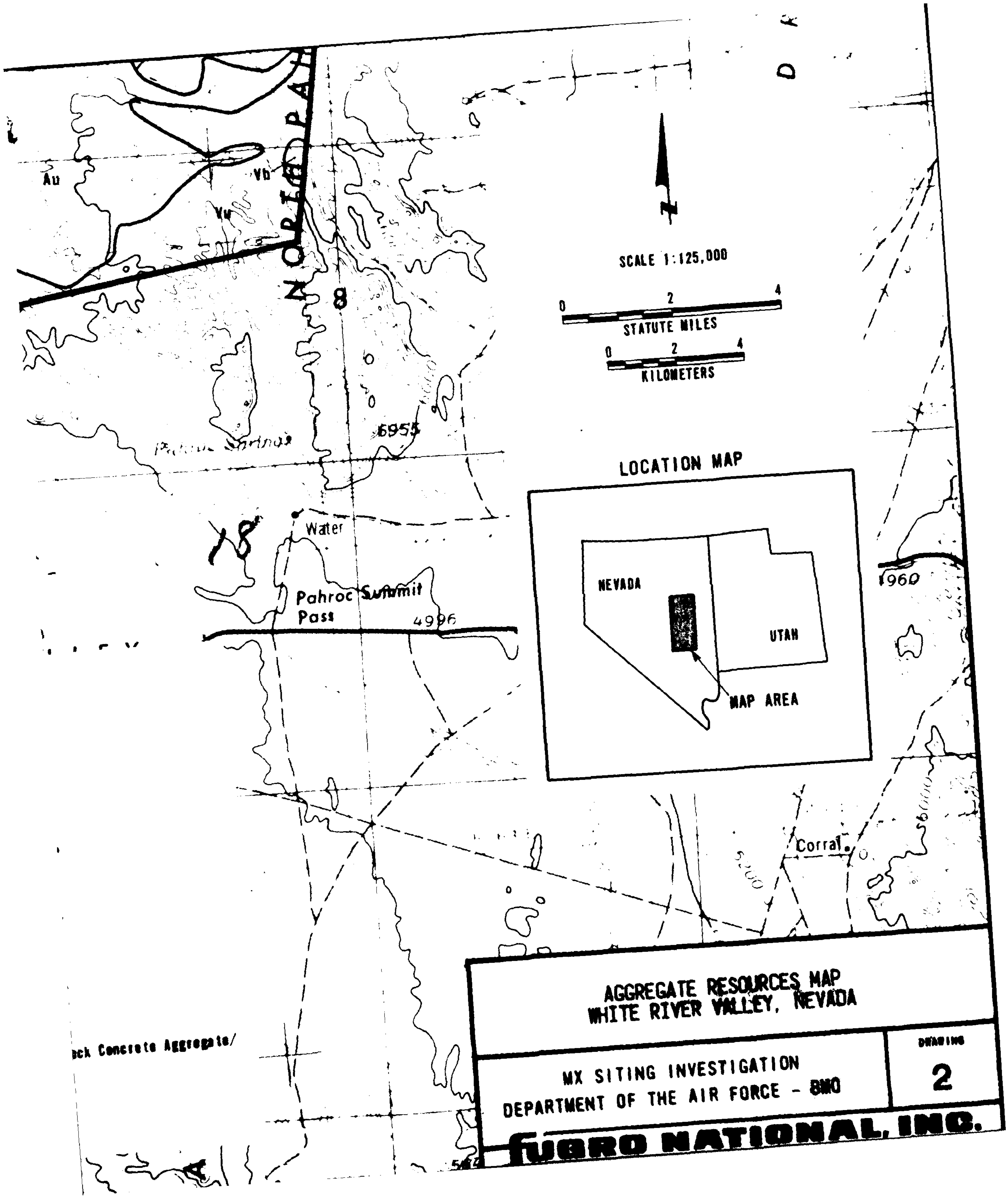
BASIN-FILL AGGREGATE SAMPLE COARSE (c) AND FINE (f)	CRUSHED ROCK SAMPLE	CLASSIFICATION
●	▲	CLASS I
◐	▲	CLASS II
○	△	CLASS III

NOTE: SEE CORRESPONDING MAP NUMBER IN APPENDIX A FOR DETAILED INFORMATION





Au
Vu
Cau
Vu
Cau
Vb
Vu
Cau
Vu
Aal
5
6780
MOUNT HOSH
8741
17
6622
RANGE
PAHRANAGAT
Water
Crystal
PAHRANAGA
25
Ash Springs
40
CLASSIFICATION SYSTEM
BASIN-FILL SOURCES
Class I - Potentially Suitable Coarse, Concrete Aggregate and Road-Base Material Source
ROCK SOURCES
Class I - Potentially Suitable Crushed Rock, Concrete Aggregate and Road-Base Materials Source
BASIN-FILL AND ROCK SOURCES
Class II - Possibly Unsuitable Coarse, Fine and/or Crushed R… Potentially Suitable Road-Base Material Source
Class III - Unsuitable Coarse, Fine and/or Crushed Rock Concrete Aggregate or Road-Base Material Source



SCALE 1:125,000
STATUTE MILES
KILOMETERS
LOCATION MAP
NEVADA
UTAH
MAP AREA
Water
Pahroc Summit
Pass
4996
6955
1960
Corral
Au
Vb
Vu
ack Concrete Aggregate/
AGGREGATE RESOURCES MAP
WHITE RIVER VALLEY, NEVADA
MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO
DRAWING
2
FUGRO NATIONAL, INC.

END

DATE
FILMED
4-82

DTIC